

2017年10月 第5期 总第109期 The 5th Issue October 2017 Issue 109

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World Optical Fibre & Cable Conference 2017

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2017年10月 第5期 总第109期

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Contents 目录

04 刊首语 Foreword

加速产业升级，共创全球线缆辉煌时代

Accelerate industrial upgrading and co-create a global cable glory era

06 新闻 / News

长飞公司公布2017年中期业绩——整体收入增幅可观，海外业务增势强劲

YOFC Announced 2017 Interim Results — Significant Growth in Overall Income and Overseas Business



截至2017年6月30日止6个月，本集团收入约达人民币4,640.1百万元，较2016年同期增长约26.2%。

The Group's revenue reached approximately RMB4,640.1 million during the Period, increased by approximately 26.2% compared with the corresponding period of 2016.

10 长飞公司成功纳入恒生港股通指数

Inclusion of YOFC in Hang Seng Index under Southbound Trading Link

12 长飞公司多次强势中标我国运营商光缆集采

YOFC Won the Biddings of Central Purchase of Optical Fibre of Chinese Operators

14 长飞公司与中国移动上海公司签署长期合作协议

Long-term Cooperation Agreement Signed by and Between YOFC and China Mobile Shanghai Co.

CRU世界光纤光缆大会自创办以来规模逐年扩大。今年，大会再次定址中国武汉光谷，于11月1-3日隆重召开，并再次由长飞公司协同主办。大会预计将迎来700名参会代表。

CRU's World Optical Fibre & Cable Conference has grown in scale year by year. This year, the conference will still be held at the Optics Valley of China (OVC), Wuhan from November 1 to 3, and be co-hosted by YOFC once again. The conference is expected to attract more than 700 representatives.



16

长飞公司闪耀IWCS
“三个首次”再度凸显全球领先实力
The “Three First” of YOFC Highlight its World's Leading Power again in IWCS Conference

18

长飞公司成立科学技术协会
YOFC Established Association for Science and Technology

20

长耀京城，飞舞缤纷——长飞公司闪耀2017年中国国际信息通信展览会
YOFC Participated in the PT Expo China 2017

24

产品 Products
“智享未来”长飞公司发布多款重磅产品
‘Intelligent Sharing of the Future’—Promotion Conference of YOFC’s New Products

26

用于下一代陆地干线传输网络的新型超低衰减大有效面积单模光纤
New Ultra-Low Loss & Large Effective Area Single-Mode Fibre for Next-Generation Terrestrial Transmission Network

34

用于高速SWDM系统的OM5多模光纤
OM5 Multimode Fiber for High Speed SWDM Systems

42

光纤激光器中用双包层掺镱光纤
Double-cladding Yb Doped Fibre In fibre Laser

48

长飞光系统公司推出千瓦级高功率光纤光栅
YOFC Optical System Company Launched 1,000W High-Power Fibre Grating

52

专题 Special
CRU世界光纤光缆大会隆重召开
行业领军人物齐聚中国光谷
Industrial leaders gathered at OVC for CRU's World Optical Fibre & Cable Conference

54

往届CRU光纤光缆大会回顾
Review of CRU's Optical Fibre & Cable Conference

58

2017年世界光纤光缆大会精彩活动集锦
Highlights of World Optical Fibre and Cable Conference 2017



加速产业升级 共创全球线缆辉煌时代

□ 本刊编辑部

2015年10月，CRU（英国商品研究所）在光纤光缆领域举办的国际盛会首次来到亚洲，选址中国光谷，以长飞为代表的中国光纤光缆厂商聚焦了全球相关行业从业者的目光。2016年，CRU世界光纤光缆大会闪耀长江之滨，600余位行业专家、研究机构嘉宾再聚中国光谷，分享前沿观点，共话产业发展。如今，2017世界光纤光缆大会拉开大幕，会议规模创历届之最，盛况空前，国际顶尖专家将共同探讨行业发展现状，展望未来发展趋势。

通过CRU大会，大量国际市场客户、上下游厂商可以进一步了解中国光纤光缆市场状况，有利于中国光纤光缆厂商开拓国际市场，迎来新的发展机遇；各大厂商聆听业内专家对行业发展趋势的预测和对未来技术发展方向讨论，获取行业前沿信息，也将为全球光纤光缆行业的繁荣发展注入新的活力。

CRU在光纤光缆行业的三届盛会均选址中国光谷，且与长飞联合办会，彰显了在中国在全球光纤光缆行业中的重要地位，也充分体现了长飞的国际影响力。凭借技术创新和核心业务的拓展，长飞引领行业发展，闪耀世界舞台。

目前，长飞已从一个“技术靠引进的制造工厂”成长

为“行业的领军者”，实现了光纤预制棒、光纤、光缆核心装备的自主开发、制造和对外销售，是全球唯一同时掌握PCVD、VAD、OVD三大主流预制棒制备工艺的企业，同时也是全球光纤光缆行业中产品最全、产业链最长的企业。CRU报告显示，截至2016年底，长飞光纤预制棒、光纤、光缆的销量分别占全球市场的18.9%、15.3%和12.1%，三大核心业务销量全面实现全球第一，产品远销全球60多个国家和地区。近年来，长飞积极响应国家“一带一路”的倡议，将目光瞄准国外，自2014年起先后在缅甸、印尼、南非合资成立了四家光纤光缆企业，海外业务持续两位数增长，获得了良好的效益。

近年来，全球光纤光缆行业方兴未艾，“中国速度”引人瞩目，长飞更是成长为行业发展的先锋。在FTTx快速部署、5G即将商用的关键机遇期，光纤光缆行业将开启新时代。共建良好行业生态、促进产业繁荣发展是所有光纤光缆厂商的共同责任，长飞也将继续携手通信产业链合作伙伴，为客户提供更好的光纤光缆产品，带动产业转型升级，为全球线缆事业的辉煌做出新的贡献。

Accelerate industrial upgrading and co-create a global cable glory era

□ The Editorial

In October 2015, the World Optical Fibre & Cable Conference, an international conference held by CRU (Commodity Research Unit) in the field of optical fibre cable, chose Asia as its conference site for the first time and sit at the Optical Valley in Wuhan, China finally. At such conference, Chinese optical fibre & cable manufacturers, represented by YOFC, attracted the attention of industry practitioners from all over the world. In 2016, the World Optical Fibre & Cable Conference was held again by CRU at the Optical Valley, on the shore of the Yangtze River, and more than 600 industry experts, research institutions and honored guests attended the conference to share cutting-edge ideas and discuss the industrial development. Today, the 2017 Optical Fibre & Cable Conference kicked off. With a meeting scale larger than ever, lots of international leading experts will attend the conference to discuss the present situation of industrial development and look into the trend of future development.

The CRU's conference enables a large number of international market customers, upstream and downstream manufacturers to further understand the status of the Chinese cable market, which is conducive to Chinese optical fibre & cable manufacturers' developing of international markets and ushering in new opportunities for development. Meanwhile, through the conference, major manufacturers may have the opportunities to listen to experts' forecast on industrial development trend and discussions on future development direction to get advanced information in the industry, which will inject new vitality to the prosperity and development of the global optical & fibre cable industry.

CRU's selection of Optical Valley, China as the conference site for three times successively and its co-host with YOFC not only shows China's important position in the fields of optical fibre & cable, but also embodies the YOFC's international influence. With the technological innovation and core business development, YOFC leads the industry development and dazzles

on the world stage.

Currently, YOFC has risen from a "manufacturing factory by introducing technology" to a "leader in the industry" and achieved the independent development, production and foreign sales of optical fibre preform, optical fibre, optical cable core equipment. It is the only enterprise who grasps the preparation technologies of all three mainstream preforms (PCVD, VAD and OVD) globally as well as an enterprise who has the most complete products and the longest chain in the optical fibre & cable industry in the world. According to a report by CRU, as of the end of 2016, the sales of YOFC optical fibre preform, optical fibre, optical cable accounted for 18.9%, 8.9% and 15.3% respectively of those in global market, the sales of the three core businesses ranked number one in the world, and its products were exported to more than 60 countries and regions in the world. In recent years, positively responding to the Belt and Road Initiative proposed by the state, YOFC targeted abroad and has jointly established four optical fibre & cable enterprises in Myanmar, Indonesia and South Africa successively since 2014. Thus, its overseas business continued double-digit growth and obtained good benefits.

In recent years, the optical fibre & cable industry in the world has been in the ascendant, the "Chinese speed" has been striking, and YOFC has developed into a pioneer in industry development as well. With the critical opportunities brought about by rapid deployment of FTTx and the forthcoming commercialization of 5G, the optical fibre & cable industry will open a new era. In such context, it is all optical fibre & cable manufacturers' common responsibilities to build a good industrial ecology and promote the industrial prosperity and development. YOFC, likewise, will continue jointing hands with partners in the communication industry chain to provide better optical fibre & cable products, drive the transformation and upgrading of industry and make new contributions to the global cable business.

长飞公司公布2017年中期业绩

——整体收入增幅可观，海外业务增势强劲

□ 本刊编辑部



8月18日，长飞公司宣布了本公司及其附属公司（简称“本集团”）截至2017年6月30日止六个月（“本期间”）之未经审核简明合并中期业绩。

作为世界领先的光纤预制棒、光纤及光缆供应商之一，截至2017年6月30日止6个月，本集团收入约达人民币4,640.1百万元，较2016年同期增长约26.2%；毛利较去年同期大幅增长53.0%，达人民币1,235.3百万元，同时毛利率由2016年上半年的22.0%提升至2017年上半年的26.6%。本集团净利润约为人民币555.7百万元，较2016年同期增长约61.6%。长飞公司2017年中营收及同比增长情况如图1所示。

按产品分部划分，约人民币2,247.7百万元的收入来自

本集团的光纤预制棒及光纤分部，较2016年同期约人民币1,929.2百万元增长16.5%，占本集团总收入48.4%；而人民币2,126.3百万元的收入来自光缆分部，较2016年同期约为人民币1,574.2百万元增长35.1%，占本集团总收入45.8%。本集团总收入升幅可观，主要受惠于三家国有电信运营商继续大力发展4G网络基础建设，以及中国政府持续推进实施“宽带中国”、“互联网+”等国家战略，上述因素尤其对光纤和光缆的需求起到促进作用，并带来额外动力。其他产品服务贡献收入约为人民币266.1百万元，较2016年同期约人民币174.2百万元增长52.7%，占本集团总收入5.8%。其他收入增长主要是随着本公司新业务，包括射频电缆、室内布线、云计算及网络工程建设及服务的发展实现增长。长飞

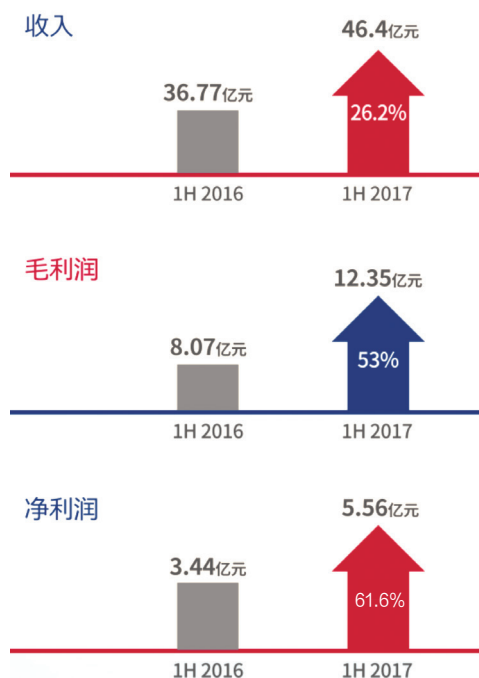


图 1 长飞公司 2017 年中营收及同比增长情况

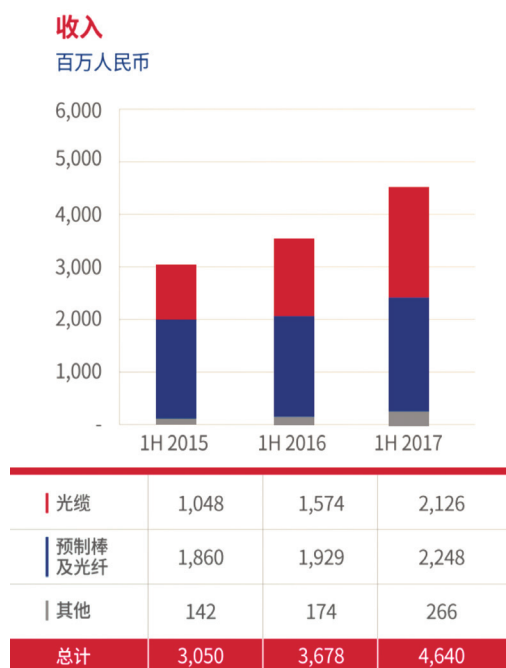


图 2 长飞公司 2017 年中收入组成

公司2017年中收入组成如图2所示。

本集团在国内外市场的业务均有可喜增长。按地区分部划分，总额约人民币4,117.9百万元的收入来自中国客户，较2016年同期增长24.0%，占本集团收入88.7%，而约人民币522.2百万元的收入来自海外客户，较2016年同期约357.4百万元增长46.1%，占本集团总收入约11.3%。海外销售增长的主要驱动是光缆和室内布线的增长，主要源于本集团持续稳定地推行国际化战略。长飞公司2017年中国内外收入占比如图3所示。

目前，本公司已就建议A股发行向中国证监会提交申请，而中国证监会已正式接纳该申请，予以受理。建议A股发行将提高本公司的综合竞争力及增强本公司的持续发展能力。

展望未来，长飞公司将紧密围绕“全球第一，行业领袖”的战略目标，推动棒纤缆业务内涵增长，强化技术创新与智能制造，深化实施国际化战略，积极探索多元化发展，提升资本运营，为股东和客户创造更高价值，致力于发展成为信息传输与智慧联接领域的领导者。

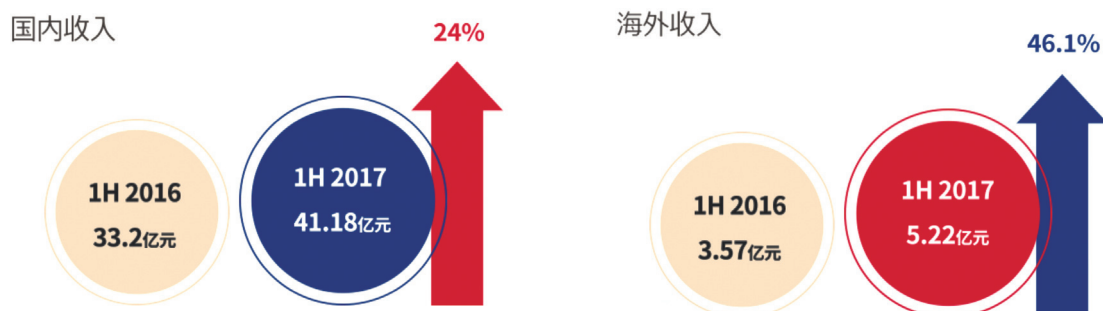


图 3 长飞公司 2017 年中国内外收入占比



YOFC Announced 2017 Interim Results — Significant Growth in Overall Income and Overseas Business

□ The Editorial

On August 18, YOFC announced the unaudited condensed consolidated results of the Company and its subsidiaries (the "Group") for the six months ended 30 June 2017(the "Period").

Being one of the global leading optical fibre preform, optical fibre and optical fibre cable suppliers, the Group's revenue reached approximately RMB4,640.1 million during the Period, increased by approximately 26.2% compared with the corresponding period of 2016. The Group's gross profit amounted to approximately RMB1,235.3 million, showing a significant increase of 53%; and the gross profit margin slightly increased from 22.0% during the first half of 2016 to 26.6% during the first half of 2017. The net profit of YOFC is RMB555.7 million, representing an increase of 61.6% over the corresponding period of last year. The YOFC's operating income and year-on-year growth in mid-2017 is as shown in Figure 1.

By product segment, revenue of approximately RMB2,247.7 million was contributed from the Group's optical

fibre preform and optical fibre segment, representing a growth of 16.5% as compared to the same period of 2016 of approximately RMB1,929.2 million and accounting for 48.4% of the Group's total revenue; while revenue of RMB2,126.3 million was contributed from the optical fibre cable segment, representing a growth of 35.1% as compared to the same period of 2016 of approximately RMB1,574.2 million and accounting for 45.8% of the Group's total revenue. The substantial growth in the Group's total revenue was mainly due to the ramp up of 4G infrastructure construction by the Three State-owned Telecommunications Operators and the ongoing national initiatives such as "Broadband China", "Internet plus" announced by the PRC government, which provide positive catalysts and bring in additional momentum, in particular, the demand for optical fibres and optical fibre cables. The composition of YOFC's income in mid-2017 is as shown in Figure 2.

The Group has recorded increased revenue from both

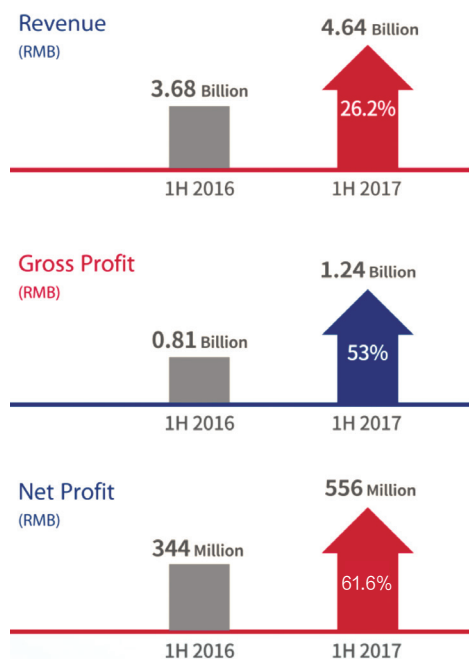
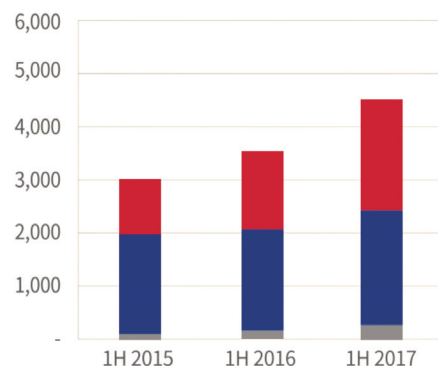


Figure 1 YOFC's operating income and year-on-year growth in mid-2017

Revenue

In million RMB



	1H 2015	1H 2016	1H 2017
Cables	1,048	1,574	2,126
Preforms and Fibres	1,860	1,929	2,248
Others	142	174	266
Total	3,050	3,678	4,640

Figure 2 Composition of YOFC's income in mid-2017

domestic and overseas markets. By geographical segment, revenue of approximately RMB4,117.9 million was from customers in the PRC, representing an increase of 24.0% as compared to the same period of 2016 and accounting for 88.7% of the Group's total revenue, while revenue of approximately RMB522.2 million was from customers in overseas, representing an increase of 46.1% as compared to the same period of 2016. The increase in overseas sales was mainly driven by the increase of optical cables and indoor wiring, mainly from the Company continued to steadily implement the internationalization strategy. The respective percentages of YOFC's domestic income and overseas income in mid-2017 is as shown in Figure 3.

The Company has submitted its application in respect

of the proposed A share offering to the CSRC, and the CSRC has officially accepted the application for further review. The proposed A share offering is expected to raise the overall competitiveness of the Company and strengthen the capability of the Company in terms of sustainable development.

Looking into the future, centering on the strategic goal of "Becoming Global No.1 and Industrial Leader", the company will push forward intensive growth of its optical fibre preforms, optical fibre and optical cables businesses, enhance technological innovation and intelligent manufacturing, intensify international strategy, actively exploit diversified development, improve capital operation, create more value for shareholders and client focus, and strive to develop itself into the leader in information transmission and smart links.

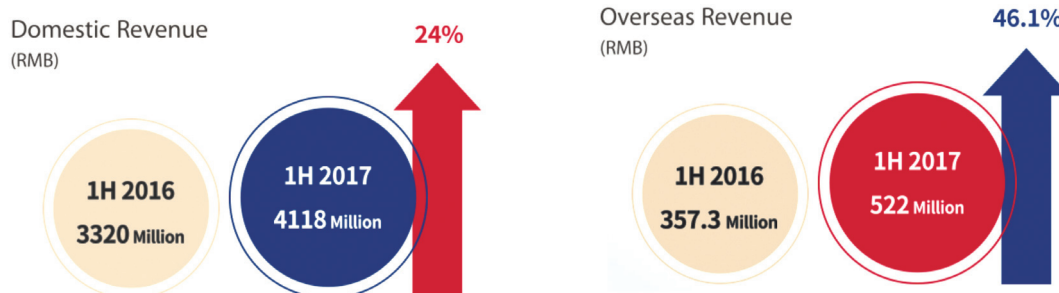


Figure 3 Respective percentages of YOFC's domestic income and overseas income in mid-2017

长飞公司 成功纳入恒生港股通指数

□ 本刊编辑部

8月16日，恒生指数公司公布半年恒生指数系列检讨结果，长飞公司成功纳入恒生港股通指数，进入港股通标的生效日期预计为2017年9月4日。恒生港股通指数是反映经港股通买卖之合资格香港上市股票表现的指标。此次，加入上述指数的包括长飞公司、中国海外宏洋集团、绿景（中国）地产等在内的34只股份，另有13只股份被剔除恒生港股通指数。

深交所于9月4日发布了关于深港通下的港股通股票名单调整的公告，因恒生综合大型股指数、中型股指数、小型股指数实施成份股定期调整，根据《深圳证券交易所深港通业务实施办法》的有关规定，港股通股票名单发生调整并自即日起生效。此次公告中的调整名单就包括此前恒生指数公司已公布的长飞公司。

2014年长飞公司在香港联交所成功上市，成为国内首家也是唯一一家在香港上市的专注于光纤预制棒、光纤和光缆等相关产品的公司。此次成功纳入恒生港股通指数，是继2015年长飞公司成功纳入MSCI全球小型股中国指数、2017年成功纳入恒生中小型指数成分股后的又一突破，再次体现了香港地区资本市场对长飞公司的高度认可。

据众多知名证券财经媒体分析，港股通资格是获得南下资金青睐的敲门砖。如果被调入港股通标的，则成交量倍增，因此，能不能拿到这个通“关”名额，对港股而言具有非常重要的意义。



Inclusion of YOFC in Hang Seng Index under Southbound Trading Link

□ The Editorial



On August 16, Hang Seng Indexes announced the HSI review results for the first half of the year, including YOFC in the Hang Seng Index under Southbound Trading Link, expected to become effective on September 4, 2017, which reflects the performance of qualified Hong Kong-listed stocks traded through HK Stocks. According to the results, there are 34 stocks including YOFC, China Overseas



Grand Oceans Group and LVJING (China) Real Estate included in the HSI and 13 stocks excluded from the same.

On September 4, Shenzhen Stock Exchange ("SZSE") issued a notice concerning the adjustment of the list of Hong Kong stocks under Shenzhen-Hong Kong Stock Connect. Considering that HSLI, HSML, HSSI are adjusted as component indexes on a regular basis, the adjustment of the list of Shenzhen-Hong Kong stocks should be made in accordance with the Measures for the Implementation of Shenzhen-Hong Kong Stock Connect and come into force as of the date of adjustment. The adjusting list includes YOFC which has been announced by HSI.

YOFC's listing on SEHK in 2014 witnessed the Hong Kong listing of China's first and only company specializing in optical fibre performs, optical fibre and cables. This successful inclusion in Hang Seng Index under Southbound Trading Link marks another breakthrough following YOFC's inclusion in MSCI Global Small-Cap China Index in 2015 and its inclusion in small-middle-cap HSI constituent stocks in 2017, and also reflects the high recognition of Hong Kong's capital market towards YOFC.

As analyzed by many well-known financial securities media, the inclusion in the index is a way for domestic investors to trade Hong Kong listed stocks. Once included in the Shenzhen-Hong Kong Connect, trading volume for a stock could double. Therefore, it is very important for Hong Kong stocks to obtain the qualification.

长飞公司多次强势中标 我国运营商光缆集采

□ 本刊编辑部



目前“宽带中国”、“三网融合”、“提速降费”等政策不断落地，尤其是《信息基础设施重大工程建设三年行动方案》提出2016~2018年信息基础设施将投资1.2万亿元，推动中国信息化基础设施建设持续升温。三大运营商大力推进4G网络基础设施建设，也极大地提高了对光纤光缆的需求。

作为全球最大的预制棒、光纤和光缆供应商，长飞公司充分抓住市场机遇，通过自主研发与技术引进，已成为全球唯一同时掌握世界三大主流预制棒生产工艺的企业，构建了领先的预制棒供应能力。

长飞公司先进的技术实力也得到了运营商的认可，在运营商光缆集采中多次以最大份额中标。中国移动2016年度普通光缆集采分两次招标，共计约1.28亿芯公里，合同价值近160亿元人民币。在中国移动2016年度普通光缆第一批次集采中，长飞公司中标份额16.77%，在第二批次的集采中，长飞公司中标份额17.75%，两次份额均荣登榜首。在中国联通2017~2018年光纤光缆集采中，长飞公司同样表现优异，以第一名（份额

19.8%）中标带状光缆集采，第二名（份额11.7%）中标普通光缆集采。

连续在运营商集采中取得骄人战绩，这些成绩的取得离不开客户的信赖与支持。自1992年正式投产以来，长飞公司光纤和光缆产品的产销量连续24年位居全国第一，光纤光缆产品及多种网络建设解决方案能够满足相关行业用户的不同需求，已广泛应用于中国电信、中国移动、中国联通等通信运营商，以及电力、广电、交通、教育、国防、航天、化工、石油、医疗等行业领域。

“长飞制造，质量先行”，长飞公司始终将质量视为立企之本，秉持“精益求精 品质卓越”的质量观，始终坚持为客户提供高质量的产品和服务，也获得了广大客户的信赖。在2016年度业绩中，长飞更是以可喜成绩再创公司业绩新高。在光纤光缆市场短缺情况下，长飞公司将充分发挥供给优势、提高产品质量，全力支持中国通信网络与信息化建设。

YOFC Won the Biddings of Central Purchase of Optical Fibre of Chinese Operators

□ The Editorial

With the continuous implementation of such policies as "Broadband China", "Integration of Three Networks", and "Faster and More Affordable Internet Connection", especially an investment of RMB 1.2 trillion in information infrastructure in 2016-2018 put forward in the Three-Year Action Plan for Major Projects of Information Infrastructure Construction, China's information infrastructure construction is pushed to develop continuously. In addition, infrastructure construction of 4G network vigorously promoted by three major operators (namely, China Mobile, China Unicom, and China Telecom) also greatly raises the demand for optical fibre and cable.

As the largest supplier of optical preform, fibre and cable in the world, by taking full advantage of the market opportunity, YOFC with the help of independent R&D and technology import, has become the only enterprise in the world simultaneously taking the production processes of preform for the three world-class preform producers and possessed the leading preform supply ability.

With advanced techniques recognized by operators, YOFC won biddings with the largest amount of shares in central purchase of optical fibre. In the two bid invitations for central purchase of ordinary optical cable of China Mobile in 2016 involving an object of 128 million fibre km and a contract price of RMB 16 billion, YOFC won a bidding with a share of 16.77% in the first central purchase and a bidding with a share of 17.75% in the second central purchase, both ranking the first place. Also, it gained good result in the bidding of China Unicom's central purchase of optical fibre and cable in 2017-2018, winning the bidding of ribbon cable as No.1 (with a share of 19.8%) and the bidding of ordinary optical cable as No.2 (with

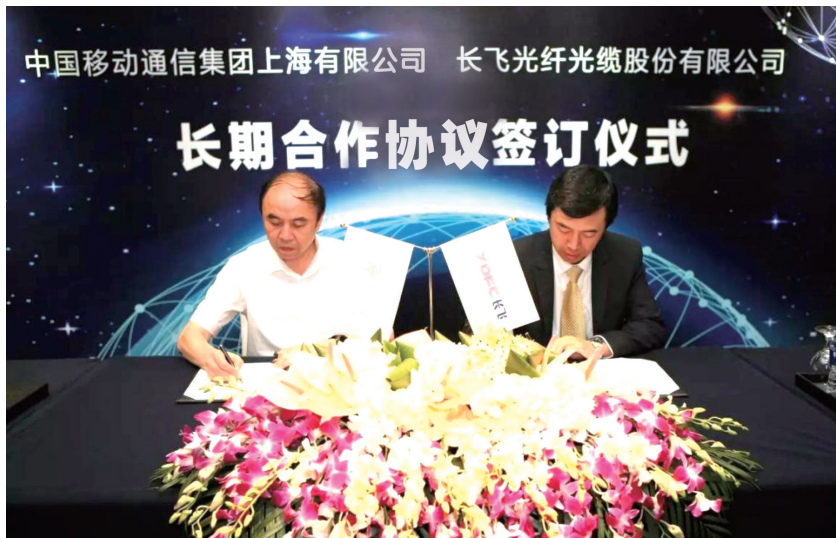
a share of 11.7%).

YOFC makes impressive achievements in operators' central purchase, which relies on customer's trust and support. Since 1992 in which YOFC's optical fibres and optical cables were put into operation, both of their output and sales have been the top 1 in China for 24 consecutive years. YOFC's optical fibres and optical cables as well as network construction solutions meeting different needs of the users in relevant sectors, have been widely applied to China Telecommunications, China Mobile, China Unicom and other communication operators, as well as electricity, radio and television, traffic, education, national defense, aerospace, chemical, petroleum, medical and other sectors.

Following the policy of "YOFC Manufacturing, Quality First", YOFC, basing the quality on enterprise operation and upholding a quality view of "keeping improving to have excellent quality", always persists in providing products and services with high quality to customers, as a result, it gains customers' trust. In 2016, YOFC even brought its results to a new height with gratifying performance results. Facing the situation where the optical fibres and cables market is in short of supply, YOFC will give full support to China's communication network and information construction by making full use of its supply advantage and improving the quality of its products.

长飞公司与中国移动上海公司 签署长期合作协议

□ 本刊编辑部



9月15日，长飞公司与中国移动通信集团上海有限公司（以下简称“中国移动上海公司”）在上海正式签署了长期合作协议，双方将在新产品应用、产品交付、资金结算等方面展开合作。中国移动上海公司采购部总经理谢勤、工程部总经理刘华、采购部副总经理林以扬以及采购部溪刚、张海舸，长飞公司销售总监郑昕、国内公网总部经理助理朱艺以及苏沪办事处王振华、谢龙等出席了签约仪式。

经过29年的行业深耕，长飞公司与中国移动等通信运营商保持着良好的合作关系，其产品及技术在国内市场获得了广泛认可。2016年10月，长飞公司以第一名（份额

16.77%，约1025万芯公里）的成绩中标中国移动2016年度普通光缆（第一批）集采；2017年7月初，中国移动公布了2016年度普通光缆（第二批）中标名单，长飞公司再次荣登榜首，中标份额17.75%。长飞公司在中国移动集采中取得的成绩是双方精诚合作、相互信任的结果。

在签约仪式上，中国移动上海公司采购部总经理谢勤表示，在当前光纤紧缺、市场需求旺盛的情况下，长飞公司是中国移动上海公司非常值得信任的合作伙伴，双方签订长期合作协议也是进一步互信互惠的明智之举，希望双方在本次签约的基础上继续推进技术合作，将产品的创新和实际应用相结合，以解决人口密集城市布线困难、管道资源紧张等实际应用中的

难点问题。

长飞公司销售总监郑昕表示，长飞公司取得的成绩离不开中国移动集团的支持。为客户提供高质量的产品和服务是长飞始终不懈的追求；未来，长飞公司将一如既往地以质量为本，为中国移动及其他广大客户提供最优质的产品和服务，同时也将积极推动长飞公司与中国移动上海公司的技术交流与合作。

作为全球最大的光纤光缆供应商，长飞公司本着“锐意进取 敦厚道义”的营销观，已经与国内外广大客户建立起了互惠共赢的良好合作氛围。本次签约是对之前彼此合作的充分肯定；继往开来，也必将开启双方合作的新篇章！



Long-term Cooperation Agreement Signed Between YOFC and China Mobile Shanghai Co.

□ The Editorial

On September 15, YOFC formally signed in Shanghai a long-term cooperation agreement with China Mobile Communications Group Shanghai Co., Ltd. ("China Mobile Shanghai Co."), under which the parties would cooperate with each other in such aspects as new product application, product delivery and fund settlement. Attendees to the signing ceremony included Xie Qin, general manager of the Purchase Department, Liu Hua, general manager of the Engineering Department, Lin Yiyang, deputy general manager of the Purchase Department, and Xi Gang and Zhang Haige from the Purchase Department, on the part of China Mobile Shanghai Co.; Zheng Xin, sales director, Zhu Yi, manager assistant of the Domestic Public Network HQ, and Wang Zhenhua and Xie Long from Shanghai and Jiangsu Office, on the part of YOFC.

Through 29 years of efforts in the industry, YOFC has been keeping a good cooperative relation with China Mobile and other communication operators, with products and technologies winning wide market recognition at both home and abroad. In October 2016, YOFC won the bid for centralized procurement of (the first batch of) common optical cable by China Mobile with the achievement of the first place (share: 16.77%, around 10.25 million core km); in early July 2017, China Mobile published the list for successful tenderers for (the second batch of) common optical cable of 2016. YOFC was at the top of the list once again, winning the share of 17.75% among the bid amount. Those achievements were attributable to the sincere cooperation between and mutual trust of YOFC and China Mobile.

At the signing ceremony, Xie Qin, general manager of the Purchase Department of China Mobile Shanghai Co., said that, YOFC was a very trustworthy partner of China Mobile Shanghai Co., amid the current optical fibre shortage and strong market demand, and the signing of long-term cooperation agreement was also a wise move of further



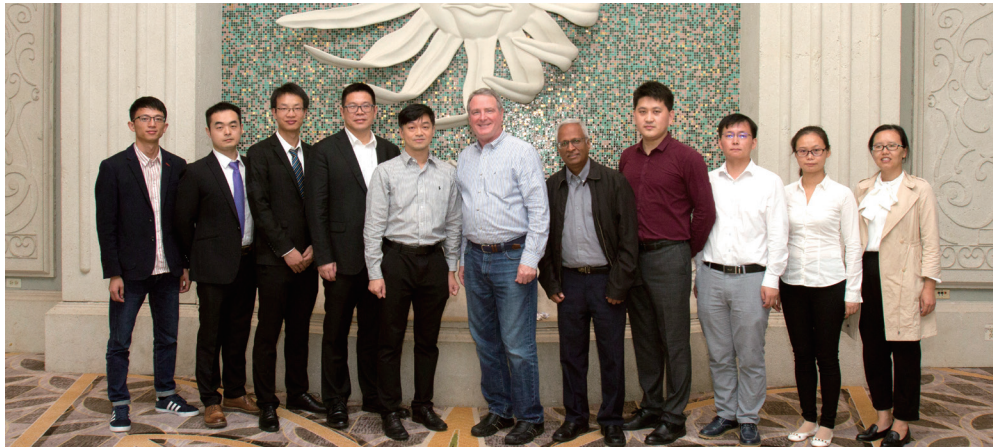
mutual trust and mutual benefit. He hoped that both sides can continue to push forward the technological cooperation on the basis of this signing, and combined the innovation of products with actual application thereof, so as to solve the difficult problems in actual application such as difficult wiring and short pipeline resource in dense populated cities.

According to Zheng Xin, sales director of YOFC, it was impossible for YOFC to make such achievements without the support of China Mobile and it has been an unremitting pursuit of YOFC to offer high-quality products and services to clients; in the future, YOFC would take quality as its fundamental as usual to provide the best products and services for China Mobile and other clients. Meanwhile, YOFC would also be active in pushing forward the technical exchange and cooperation between YOFC and China Mobile Shanghai Co.

As the largest optical fibre and optical cable supplier in the world, YOFC has created a sound atmosphere of cooperation featuring mutual benefit and win-win with domestic and abroad clients, based on the marketing view of "Forging ahead with Determination, Upholding Honesty and Morality". Not only is the signing a full affirmation to past mutual cooperation of the two sides, but also it will surely open a new chapter for our future cooperation!

长飞公司闪耀 IWCS “三个首次” 再度凸显全球领先实力

□ 本刊编辑部



业之首，这是中国企业在光缆行业顶级专业会议中发表论文数量首次超过国际同行。

中国人首次担任 IWCS 执行委员会 委员

在今年4月举行的IWCS执行委员会例会上，长飞公司研发中心副总经理兼制造中心光缆技术总

监熊壮博士受邀担任IWCS执行委员会委员，这也是IWCS大会首次任命中国人在该委员会中担任职务。

这三个“首次”体现了中国企业在全球光纤光缆行业中逐渐由参与者转变为引领者，并发挥越来越大的影响力。

在光纤制造主题会议环节，长飞公司首席光纤科学家马泰先生介绍了未来光纤的发展趋势（大有效面积和超低衰减），详细探讨了衰减机理以及各种降低衰减的思路，并展示了长飞公司的几种超低衰减系列光纤的产品性能。在演讲提问环节，多位同行专家对长飞公司的研究成果和产品表现出浓厚的兴趣，并进行了积极的提问及探讨，分会主席也对马泰先生的演讲给予了极大肯定。

在新型光缆主题会议环节，长飞公司展示了其采用PP材料用于ADSS光缆的应用成果、关于在冰冻环境下阻水材料对全干式光缆性能影响的研究、全干式光缆的可靠性以及全干式光缆的高速二次套塑工艺技术，标志着长飞公司在全干式光缆的研究领域已位居行业领先地位。

在其他各个分会上，长飞参会的技术人员就各自的研究方向及成果进行了演讲和展示，获得了参会人员的高度关注。

在本次IWCS执行委员会例行会议上，IWCS总裁David Kiddoo先生高度评价了熊壮博士在组织中方人员积极参与本次会议方面所做的协调努力，并对长飞参会团队给予了极大肯定。正如David Kiddoo先生在本届会议多次提到的，“在全球光缆行业，中国力量正在引领世界”。

10月9-11日，第66届国际光缆及连接方案技术大会（IWCS）在美国奥兰多成功举办，该会议是全球光缆行业历史最悠久、最具影响力的专业技术会议，每年业内最顶级的专家都会齐聚于此，对光缆行业最前沿的产品、技术和发展方向进行展示及研讨。

首次成为 IWCS 伙伴级赞助商

作为全球光纤光缆行业领军企业，长飞公司受邀参会。作为首家成为IWCS伙伴级赞助商的中国企业，长飞公司在主题会议中发表高质量论文20篇，其中14篇为主题论文演讲，6篇为张贴论文展示，内容涉及新型通信光纤（包括ULLG.652、ULLG.654、高性能低成本大尺寸G.657预制棒），少模光纤的制备（包括超低衰减4模光纤和9模光纤）及测试系统，宽带多模光纤（WBMMF）在短波分复用系统（SWDM）中的应用，光纤寿命研究及光纤非线性效应测试，光纤超高速拉丝工艺，全干式光缆的设计和性能及可靠性研究，光缆高速二次套塑工艺的研究，隐形光缆的应用和恶劣环境下低烟无卤室内外两用光缆的开发等。

论文发表数量首次超国际同行

本届会议共有超过100家企业参加，共发表论文146篇，长飞公司本次发表论文数量约占会议论文总量的14%，位列所有企

The 'Three First' of YOFC Highlight its World's Leading Power again in IWCS Conference



□ The Editorial

The 66th International Conference on cable and connection technology, i.e., IWCS, was successfully held in Rolando, USA from 9th to 11th October. The conference is believed to be the most historical and the most influential conference in professional and technical aspects in global cable industry, gathering top-class experts within the field each year to display and to discuss the emerging products, technologies and development direction of cable industry.

Become the sponsor of IWCS at the partner level for the first time

As the leading enterprise of global fibre optic cable industry, YOFC was invited to participate in the conference. As the first Chinese enterprise becoming the sponsor of IWCS at the partner level, YOFC published 20 high quality articles in theme conference, 14 of which were theme speeches, and 6 were display of posted articles, involving new communication optical fibre (including ULLG.652, ULLG.654, high performance, low cost and large size G.657 perform rod), preparation of few-mode fibre (including ultra-low attenuation 4-mode fibre and 9-mode fibre), test system, application of broadband multimode fibre (WBMMF) in shortwave division multiplexing system(SWDM), fibre life research and optical fibre nonlinear effect test, optical fibre high speed wire drawing process, design and research on the performance and reliability of full dry type optical cable, application of invisible optical fibre, development of low smoke halogen free indoor and outdoor cable under severe environment and so on.

The number of articles published beyond international counterparts at the first time

There were more than 100 companies participating in this conference with 146 published articles. YOFC's publish number this time reached 14% of the total amount which ranked to be the first among all enterprises. This is also the first time that Chinese enterprise has published more articles than international counterparts in such top-class professional conferences of the cable industry.

The first time of Chinese was appointed as the Executive Committee of IWCS

On the regular conference of IWCS Executive Committee held in April this year, Dr. Xiong Zhuang, the Vice General Manager of YOFC R&D Center and Cable Technical Director of Manufacture Center, was invited to appointed as the Executive Committee of IWCS. This is also the first time that IWCS has appointed Chinese to serve in the Committee.

These three "First" reflected that Chinese enterprise has gradually become the leader from participant in global optical fibre industry with its increasing impact.

During the theme conference on optical fibre manufacturing, Mr. Matthew, the Chief Fibre Scientist of YOFC, introduced the future trend of development in optical fibre (large effective area and ultra-low attenuation), discussed the attenuation mechanism and various concept to reduce the attenuation and displayed the performance of several kinds of ultra-low attenuation series optical fibre products. During the Q& A session, several peer experts have shown keen interest in YOFC's research results and products, actively put forward questions to discuss. Accordingly, the Chairman of the Branch also gave a great affirmation to Mr. Matthew's speech.

During the new type optical cable theme conference, YOFC displayed the achievement of applying PP material in ADSS cable, including research on the effect of waterproof material to the performance of fully dried optical cable under frozen environment, reliability of fully dried optical cable as well as high speed secondary coating technology for fully dried optical cable, which indicate that YOFC has become the industrial leader on the field of research on fully dried cable.

During other sub-conferences, YOFC technicians delivered speeches and displayed their own research directions and achievements, which received wide attention from participants.

In the regular conference of IWCS Executive Committee this time, Mr. David Kiddoo, the President of IWCS, highly evaluated the coordination effort of Dr. Xiong Zhuang in organizing Chinese people actively participated in this conference, and left positive feedback to YOFC team after the conference. As Mr. David Kiddoo mentioned several times during this conference, "Chinese power is leading the world in global cable industry."



长飞公司成立科学技术协会

□ 国家重点实验室 吕大娟

6月7日，长飞公司科学技术协会（以下简称“长飞科协”）成立大会隆重召开。武汉市科协党组成员、副主席陈光勇，东湖新技术开发区科技创新局局长李世庭，武汉市科协企事业单位部部长宋卫华，长飞公司执行董事兼总裁庄丹，副总裁闫长鹏，技术总监罗杰，研发中心总经理王瑞春等出席了此次会议。

大会由长飞公司执行董事兼总裁庄丹致辞，庄总表示，科技研发人员和高技术人才是长飞公司的宝贵资源和重要的员工群体，长飞科协的成立是公司在创新驱动发展进程中的一件大事，对加强企业文化建设，加快提高企业技术创新能力具有十分重要的意义。武汉市科协企事业单位部部长宋卫华宣读了武汉市科协同意长飞公司成立企业科协的批复

文件，大会通过了《长飞光纤光缆股份有限公司科协章程》，选举并产生了以长飞公司庄总为主席的第一届长飞科协委员会领导机构。

作为新当选的长飞科协主席，庄总在会上发表了重要讲话，并对长飞科协的未来工作提出了两点要求：一是多走访、多取经，向市、区级各科协多学习成功经验；二是要围绕公司未来发展战略而有所为，有针对性地做好重要工作。

武汉市科协党组成员、副主席陈光勇在讲话中充分肯定了长飞公司在全球光纤光缆行业所取得的重要成就和领先地位，并对长飞科协提出了三点宝贵建议：长飞科协要把学术交流和科学普及放在优先的地位，通过学科交叉、创新发展，把科协组织真正发展为“科技

工作者之家”；要切实服务于长飞公司的中心任务，做好创新驱动发展，充分发挥长飞核心科技人才的积极性，把建立院士工作站纳入议程；希望长飞科协的科技工作者团结拼搏、开拓创新，充分发挥科技优势，为武汉市、湖北省的科技发展服务。

东湖新技术开发区科技创新局局长李世庭对长飞公司成立企业科协表示祝贺，并希望长飞科协在省、市科协的指导下，按照章程做好科协工作。同时李局长强调，科普是一辈子的事情，长飞科协要传承好科技创新文化，努力发展成为开发区和武汉市科协的优秀示范科协组织，开发区将在后勤保障、人才服务方面提供必要的支持，协助推动长飞公司科研水平更上一层楼。

YOFC Established Association for Science and Technology

□ Lv Dajuan from the State Key Laboratory

The inaugurating meeting for Association for Science and Technology (hereinafter referred to as "YOFC AST") of YOFC was ceremoniously held on June, 7. Chen Guangyong, Member of the CPC Leadership Group and Vice Chairman of Wuhan Association for Science and Technology, Li Shiting, Director-general of Science and Technology Innovation Bureau of East Lake High-tech Development Zone, Song Weihua, Director of Enterprise and Institution Department of Wuhan Association for Science and Technology, Zhuang Dan, YOFC Executive Director & President, Yan Changkun, Vice President, Luo Jie, Technical Director, Wang Ruichun, General Manager of the R&D Center and other representatives attended the meeting.

At the meeting, Zhuang Dan, YOFC Executive Director & President delivered an address, noting that scientific R&D personnel and high-tech talents are valuable resources and significant employees of the company. The establishment of YOFC AST is an important event for the company during its process of innovation-driven development and of great significance for strengthening enterprise culture construction and speeding up the improvement of corporate technological innovation capacity. Song Weihua, Director of Enterprise and Institution Department of Wuhan Association for Science and Technology, read out the approval document on YOFC's establishment of association for science and technology. The meeting adopted the Articles of Association for Science and Technology of Yangtze Optical

Fibre and Cable Joint Stock Limited Company, selected and constituted the first leading organ of YOFC AST Committee presided by Zhuang Dan, YOFC President.

As the newly-elected Chairman of YOFC AST, President Zhuang delivered a keynote speech at the meeting and put forward two requirements for the future work of YOFC AST: the first is to visit more and study more to learn the successful experience from municipal or regional associations for science and technology; the second is to do the relevant and important work around YOFC's future development strategy.

At his speech, Chen Guangyong, Member of the CPC Leadership Group and Vice Chairman of Wuhan Association for Science and Technology, fully acclaimed the major achievements and leading status of YOFC in the global optical fibre and cable industry and put forward three valuable suggestions for YOFC AST that YOFC AST should give priority to academic exchange and scientific popularization, achieve interdisciplinary and innovative development and turn the association into a genuine "home to scientific and technological workers"; earnestly serve the central task of YOFC, make the innovation-driven improvement, give full play to the enthusiasm of core scientific and technological talents in YOFC and put the establishment of academician



workstation into the agenda; scientific and technological workers in YOFC AST should work hand in hand, pioneer to innovate and give full play to the scientific advantage to make contribution to the scientific development of Wuhan and Hubei Province at large.

Li Shiting, Director-general of Science and Technology Innovation Bureau of East Lake High-tech Development Zone, congratulated YOFC on its establishment of association for science and technology and wished YOFC AST to do a good job of AST in line with the articles under the guidance of the provincial and municipal associations for science and technology. Meanwhile, Director-general Li stressed that as science popularization is a lifelong cause, YOFC AST should inherit the scientific and technological innovation culture and strive to be an outstanding and exemplary association of the development zone and Wuhan Association for Science and Technology. The development zone will provide necessary support in terms of logistics and talents to help the scientific research level of YOFC move to a higher level.

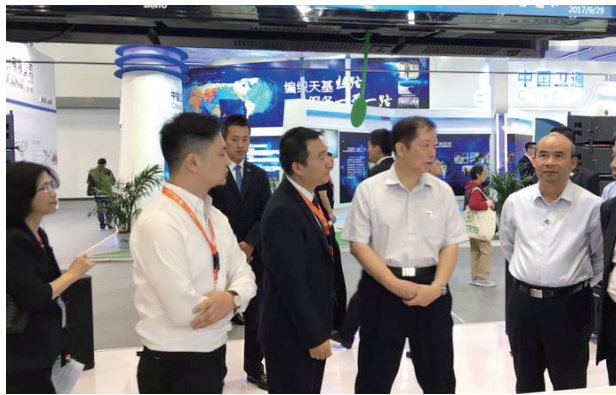


长耀京城，飞舞缤纷 ——长飞公司闪耀 2017 年中国国际信息通信展览会

□ 本刊编辑部



9月27~30日，2017年中国国际信息通信展览会隆重召开，作为全球最大的光纤预制棒、光纤、光缆供应商，长飞公司携多款重磅产品精彩亮相，应邀参加“2017年中国信息通信业发展高层论坛”、“ICT中国·2017高层论坛”等，并在同期“2017年中国国际信息通信展览会年度系列风云奖项”、“2016-2017中国通信产业榜”中斩获多项重量级奖项。长飞公司的系列活动引起广大客户、行业专家以及政府、协会、媒体等各方的关注。



工信部副部长、党组成员刘利华考察长飞展台



长飞展台持续火爆

长飞公司本次携集团子公司精彩亮相2017年中国国际信息通信展览会，展示了长飞公司完整的产品系列和相关多元化的成果。

本次展会，长飞公司集中展示了在通信光纤领域的最新成果：远贝[®]超强超低衰减大有有效面积光纤和超贝[®]宽带OM5弯曲不敏感多模光纤。长飞公司在本次展会上还集中展示了多种解决方案，展现了长飞公司作为综合解决方案提供商和服务商的强大实力，这些方案包含：5G布线、数据中心布线、轨道交通布线、农村光网布线、应对路由紧张、消费电子AOC、FTTx等。

除了新型光纤、多种解决方案的展示，长飞公司还展出了特种光纤产品、高功率光纤光栅、长飞电商平台等。众多的客户、媒体及业界相关人士前来长飞展台参观、洽谈，长飞的发展和进步也得到了相关领导的关心和肯定。

高层论坛分享前沿观点

在展会同期举办的“2017年中国信息通信业发展高层论坛”，长飞公司销售总监郑昕应邀出席，并发表《长飞公司“一带一路”战略实践》主题演讲。郑总对目前光纤光缆行业面临的机遇和挑战进行了全面分析，介绍了依托

国家“一带一路”倡议，长飞公司近年来的国际化布局以及未来发展规划。未来，长飞公司还将坚决贯彻落实国家“一带一路”倡议，深入实施国际化，为全球客户提供满意的光连接解决方案。

长飞公司研发中心副总经理兼制造中心光缆技术总监熊壮出席“2017中国光通信产业发展大会”并进行主题为《5G承载及布线方案》的演讲。熊总表示，长飞公司在过去29年里，一直专注于光纤光缆研发制造及其相关方案的开发。针对5G提出的新需求，长飞公司对5G前传提供了多种拉远光缆布线方案。针对5G高频密集组网，长飞公司提出小型化、高密度光缆布线方案。

斩获业内重要奖项

本次展会期间揭晓了“2017年中国国际信息通信展览会年度系列风云奖项”和“2016-2017中国通信产业榜”，长飞公司荣获“产业贡献奖——2016~2017年度中国通信产业光纤光缆贡献企业”、“市场竞争力奖——2016~2017年度中国通信智能制造领军企业”、“光通信年度产业杰出贡献奖”、“年度优秀云计算数据中心解决方案奖”，长飞公司超贝[®]宽带OM5弯曲不敏感多模光纤荣获“2017年中国国际信息通信展览会最具竞争力产品奖”。



YOFC Participated in the PT Expo China 2017

□ The Editorial

From September 27 to September 30, PT Expo China 2017 has been held solemnly. As the largest global supplier for optical fibre preform, optical fibre and cable, YOFC made a splendid pose carrying a variety of super products at the invitation of "China Information and Communication Industry Development Summit 2017", "ICT China High Level Forum 2017", also gaining multiple heavy weight class awards in the "Annual Series of Wind and Cloud Awards for PT/EXPO CHINA 2017" and "List of China Communication Industry 2016-2017" in the corresponding period. The series of activities by YOFC has aroused wide attention from the vast clients, industry experts and government, associations and media.



YOFC Booth Sustained Hot

This time YOFC, together with the Group branches, made a wonderful appearance in PT/EXPO CHINA 2017 and displayed the complete product series and relevant diversified achievements of the company.

At the Expo, YOFC focused on showing the latest achievement in communication optical fibre: FarBand[®] Ultra damping large active area optical fibre and Maxband[®] Wideband OM5 Bend Insensitive Multimode Fibre. YOFC also displayed multiple solutions at the Expo and its powerful strength as a comprehensive solution and service provider. The solutions include: 5G cabling, data center cabling, rail transit cabling,

rural optical network cabling, coping with route nervousness, consumer electronics AOC, FTTx and so on.

Apart from the display in new type of optical fibre and various solutions, YOFC also showed special optical fibre, high-power FBG, YOFC E-commerce platform etc. Numerous clients, media and relevant personage in the industry came to YOFC booth for a visit and talk. The development and progress made by YOFC also received care and affirmation of relevant leaders.

Share of Cutting-edge Viewpoints at the High Level Forum

In the "China Information and Communication Industry Development Summit 2017" held with the Expo simultaneously,



Zheng Xin, Sales Director of YOFC was invited to be present and delivered a keynote speech of “The Belt and Road” Strategic Practice of YOFC. The Director made a comprehensive analysis of the opportunities and challenges confronting the optical fibre and cable industry at present, introduced the internationalized layout and future development planning of YOFC in recent years by relying on the national proposal of “The Belt and Road”. In the future, YOFC will also firmly implement this national proposal, go deep into the internationalization initiative and provide satisfactory optical connection solutions to global clients.

Xiong Zhuang, Vice-General Manager of YOFC R&D Center and Optical Cable Technical Director of Manufacturing Center attended “China Optical Communication Industry Development Conference 2017” and addressed a speech themed on 5G Bearing and Cabling Scheme. Mr. Xiong expressed that YOFC has always been concentrating on R&D manufacturing and development of related solutions concerning optical fibre and cable over the past 29 years. Specific to the new demand raised by 5G, YOFC has provided multiple zooming-out

cabling solutions to 5G forward. Aiming at 5G high frequency intensive networking, YOFC came up with the downsizing and high density optical cabling solution.

Gaining Significant Awards in the Industry

“Annual Series of Wind and Cloud Awards for PT/ EXPO CHINA 2017” and “List of China Communication Industry2016-2017” were announced during this Expo. YOFC has the honour to win “Industry Contribution Award-2016~2017 Annual China Communication Industry Optical Fibre and Cable Contributing Enterprise”, “Market Competitiveness Award-2016~2017 Annual China Communication Intelligent Manufacturing Leading Enterprise”, “Optical Communication Annual Industry Outstanding Contribution Award”, “Annual Excellent Cloud Computing Data Center Solution Award”. The YOFC Maxband® Wideband OM5 Bend Insensitive Multimode Fibre was awarded the “The Most Competitive Product Award of PT/EXPO CHINA 2017”.



“智享未来” 长飞公司发布多款重磅产品

□ 战略中心 张方海



2017年中国国际信息通信展览会期间，长飞公司召开了以“智享未来”为主题的新品发布会，会议邀请到各大运营商代表、行业客户、行业协会及各大通信媒体参会。长飞公司副总裁闫长鹏致开幕辞，中国通信企业协会通信电缆光缆专业委员会秘书长段志刚发表重要讲话。

会上，长飞公司发布了超低衰减光纤产品系列、超贝[®]宽带OM5弯曲不敏感多模光纤、高功率光纤激光器用光纤光栅、FIBBR[®]HDMI2.1光纤线、长飞iCONEC[®]G4数据中心互连解决方案、光纤在线互动教育解决方案、全光桌面云教育解决方案在内的光纤及解决方案。

长飞公司始终以市场需求为导向，在持续做大主营业务



的同时，在各条产品线继续深耕，积极研发并开展符合技术发展规律和客户需求的新产品。随着社会各界对信息消费的需求迅猛增长以及通信技术的快速发展，4G、5G、FTTx等通信网络持续规模建设，全球将在更广领域内逐步构建泛在的信息传输网络。未来，长飞公司将继续以“智慧联接 美好

生活”为使命，秉持“客户 责任 创新 共赢”的企业核心价值观，致力成为信息传输与智慧联接领域的领导者。

后续文章将分别对远贝[®] 超强超低衰减大有效面积光纤、超贝[®] 宽带OM5弯曲不敏感多模光纤、光纤激光器中的双包层掺镱光纤、千瓦级高功率光纤光栅等长飞公司重磅产品进行详细介绍。

'Intelligent Sharing of the Future'- Promotion Conference of YOFC's New Products

□ The Editorial

On the afternoon of September 27th, YOFC held a promotion conference of new products with the theme of 'Intelligent Sharing of the Future'. This conference has invited representatives from operators, clients, industry associations and media. During the conference, Yan Changkun, the Vice President of YOFC, delivered the opening speech and Duan Zhigang, the Secretary-general of the Specialized Committee of Communication Cable and Optical Cable of China Association of Communications Enterprises, gave keynote address.

YOFC launched a variety of new products and solutions at the event, including Ultra Low Loss Fibre, Maxband[®] WideBand OM5 Bend Insensitive Multimode Fibre, High-power FBG for Fibre Laser, FIBBR[®] HDMI2.1 optical cable, YOFC iCONEC[®] G4 Data Center Interconnection Solution, Fibre Online-Interactive Education Solution and All-optical Desktop Cloud Education Solution etc.

Always taking the demand-oriented philosophy, YOFC will continue to expand its primary product categories and explore products in line with the law of technological development and customer requirement. With the rapid growth of demand for information consumption by all walks of life as well as the fast development of communication technology and the sustainable scale construction of such communication networks as 4G, 5G and FTTx, a global information transmission network



will be gradually established in broader fields. In the future, YOFC will be devoted to becoming the leader in information transmission and smart link by shouldering the mission of 'Smart link, Better life' and holding fast to the core value of 'Client Focus, Accountability, Innovation, Stakeholder Benefits'.

A detailed introduction will be given in the following articles concerning the YOFC super products like FarBand[®] Ultra damping large active area optical fibre and Maxband[®] Wideband OM5 bend insensitive multimode fibre, dual-cladding yb-doped fibre for fibre laser, KW class high-power FBG etc.



畅达未来

Smart Link
Better Life

用于下一代陆地干线传输网络的 新型超低衰减大有效面积单模光纤

□ 研发中心 张磊

目前中国陆地干线网敷设的光纤主要以普通G.652.D光纤为主，而20世纪九十年代铺设的光缆已经达到预期20~25年的使用寿命，随着400G和超400G系统的快速发展，今后几年将面临着对主干网络光缆进行升级换代的要求。因此，如何为长距离陆地干线光缆选择合适的光纤，对于网络运营商和光通信公司而言都是一个急需解决的问题。为了获得最佳的系统性能，如果将

超低衰减和大有效面积的特性融合到一根光纤中去，这种光纤将会是下一代通信光纤中最完美的光纤。

1.G.654.E 建议指标

表1给出了目前正在讨论中的G.654.E光纤指标和长飞超低衰减大有效面积光纤的性能指标范围。最新的G.654.E光纤标准相对于原有的G.654.B&D最大的区别在于收紧了模场直径

和1550nm色散系数的范围，并根据陆地应用的特点，对光纤弯曲损耗性能做了进一步的要求，同常规G652.D宏观弯曲标准一致。长飞公司的超低衰减大有效面积光纤（远贝®超强）能够满足甚至优于现有最严格的G.654.E标准建议。

2. 光纤设计和制造

光纤折射率剖面结构示意图如图

表 1 ITU-T G.654 相关标准要求与长飞超低衰减大有有效面积光纤产品对标

参数名称		ITU-T G.654标准			长飞公司	长飞公司
		G.654.B	G.654.D	G.654.E	远贝®超强-110	远贝®超强-130
*模场直径 @1550nm (um)	名义范围	9.5-13.0	11.5-15.0	11.5-12.5	11.2-12.0	12.2-13.0
	正负偏差	±0.7	±0.7	±0.7		
有效面积典型值@1550nm (um ²)		\	\	\	110	130
*光缆截止波长 (nm)		≤1510	≤1530	≤1530	≤1530	≤1530
*衰减系数 @1550nm (dB/km)		≤0.22	≤0.20	≤0.23	≤0.17 (常规)	≤0.17 (常规)
					≤0.16 (低衰)	≤0.16 (低衰)
					≤0.15 (超低衰)	≤0.15 (超低衰)
*宏弯 (R30mm×100 turns)	1550nm (dB)	TBD	TBD	TBD	≤0.05	≤0.05
	1625nm (dB)	≤0.5	≤2.0	≤0.1	≤0.1	≤0.1
*色散系数 @1550nm (ps/nm/km)		≤22	≤23	17-23	17-22	17-23
色散斜率 @1550nm (ps/nm ² /km)		≤0.070	≤0.070	0.050-0.070	0.050-0.070	0.050-0.070
PMD (ps/km ^{1/2})		≤0.2	≤0.2	≤0.2	≤0.2	≤0.2
几何参数						
包层外径 (um)		125±1	125±1	125±1	125±1	125±1
芯包同心度 (um)		≤0.8	≤0.8	≤0.8	≤0.8	≤0.8
包层圆度 (%)		≤2.0	≤2.0	≤2.0	≤1.0	≤1.0

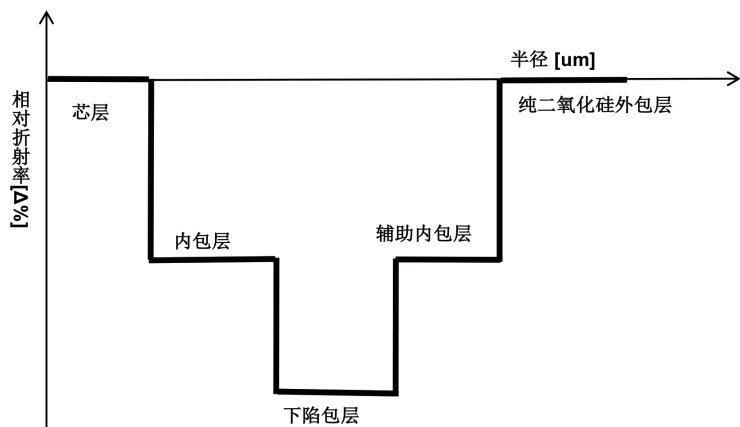


图 1 光纤折射率剖面结构示意图

1所示。与传统的掺氟外包层结构的超低衰减大有有效面积光纤相比，长飞采用纯二氧化硅（SiO₂）作为光纤的外包层，由于减少了氟掺杂材料的使用量，无论从材料制备成本、制备技术难度还是从环保等角度来看，长飞的

超低衰减大有有效面积光纤产品在成本上更具有竞争力。

3. 光纤和光缆性能

3.1 光纤衰减

无论从理论还是实际角度，更

低的衰减可以减少中继站的数量并降低长距离通信网络的维护成本，因此不断降低光纤衰减系数是光纤研发的长期目标。对于光纤研发和制造企业而言，在理论上对衰减组成的各个部分进行定性和定量的分析，可以有效地帮助我们找到降低衰减的最优途径，在实际工作中指导我们的工作方向。

表2给出了超低衰减大有有效面积 G.654.E 光纤和标准 G.652.D 光纤在 1550nm 处各损耗贡献因素的具体对比数值。目前长飞公司正在研发第二代超低衰减光纤技术，并已经取得关键性突破，其有效面积将更大，典型衰减也将更低。

3.2 宏弯损耗

另一个影响大有有效面积光纤在陆地使用的因素是陆地缆的安装和应用环境比海缆更复杂，经常需要

表 2 标准 G.652.D 和超低衰减光纤的衰减谱分解

	标准 G.652.D	超低衰减大有效面积G.654.E
瑞利散射贡献	0.162 dB/km	0.127 dB/km
红外吸收贡献	0.014 dB/km	0.014 dB/km
其他	0.016 dB/km	0.012 dB/km
总衰减	0.192 dB/km	0.153 dB/km

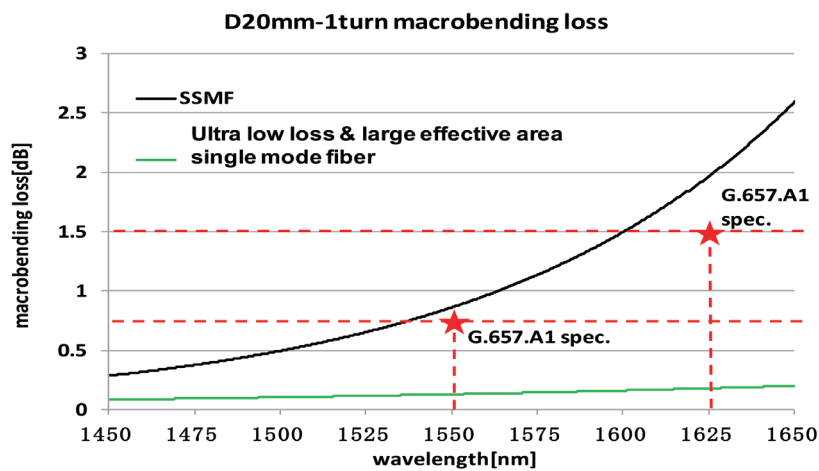


图 2 宏弯损耗对比

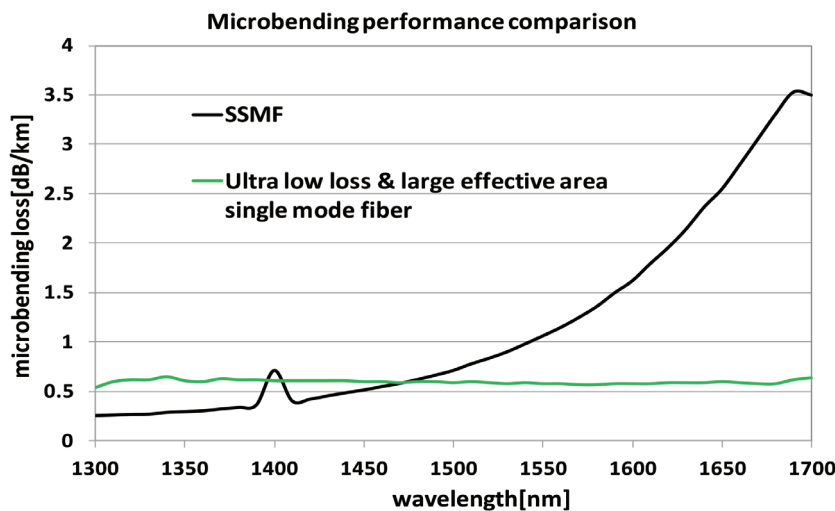


图 3 超低衰减大有效面积光纤同普通 G652 光纤的微弯损耗对比

经过一些转角或需要在分线盒内留有余长盘纤，因此必须保证陆地干线光纤比海缆光纤拥有更好的抗宏观弯曲性能。

影响宏弯的主要因素是光纤的剖面设计。辅助下陷内包层结构是弯曲不敏感G.657光纤所使用的主要设计方案，而在我们的超低衰减大有效面积光纤设计中，我们使用类似的结构，将下陷内包层的体积优化至一个合理的值以获得更好的抗弯曲性能。如图2所示，我们的超低衰减大有效面积光纤较标准G.652.D单模光纤有着更优异的抗弯曲性能，完全满足并优于G.657.A1标准，从而可以满足陆地干线实际部署中各种苛刻复杂苛刻环境的要求。

3.3 微弯损耗

目前业界对大有效面积光纤在陆地使用的最大担心就是微弯性能。微弯性能是影响成缆设计和成缆过程的重要因素，优异的微弯性能可以减小成缆设计和成缆过程的难度，并且可以改进光缆在不同应用条件下，尤其是极端环境中的性能稳定性。但目前主流的增大光纤有效面积的方法是增加芯层直径或降低芯层相对折射率，这两种设计都会对光纤的微弯带来负面影响。而长飞公司的超低衰减大有效面积光纤通过特殊优化设计的下陷内包层结构，并结合特殊的光纤涂覆工艺，有效地降低了超低衰减大有效面积光纤的微弯损耗。图3为长飞公司有效面积为 $110 \mu\text{m}^2$ 的超低衰减光纤和标准G.652.D单模光纤的微弯性能

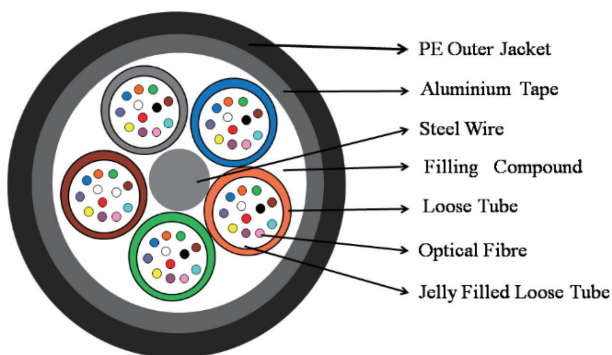


图4 光缆结构示意图

对比，可见长飞公司的光纤具有优异的微弯性能，在全波段范围内的典型微弯损耗低于0.5dB/km。

3.4 光缆 TCT 性能

如上文讨论，由于陆地干线光缆的使用环境较海洋光缆使用环境更为复杂苛刻，陆地缆需要在经历更剧烈的温度变化的条件下仍然保持链路损耗的稳定性。为了进一步验证长飞公司的光纤在成缆后的性能，我们进行相关成缆实验。在相关标准汇总，通常使用光缆温度循环测试检测衰减随温度的变化。在实验中，我们将12芯超低衰减大有有效面积（ $110 \mu m^2$ ）光纤置于一个GYTA的光缆管内进行TCT实验，图4为我们的光缆结构示意图。

由图5我们可以发现，当温度在-40摄氏度到+70摄氏度的范围内变化时，我们的超低衰减大有有效面积（ $110 \mu m^2$ ）光缆的衰减变化小于0.01dB/km，远远优于IEC和ITU-T标准规定的0.05dB/km。

3.5 成缆过程中的衰减变化

图6为长飞超低衰减大有有效面积光纤在成缆前后的衰减变化。该数据统计基于长飞公司在2016年提供给中国移动的21000芯公里超低衰减 $110 \mu m^2$ 大有有效面积光纤的成缆结果。其中蓝色柱状图为原始长盘光纤的原始衰减分布，蓝色线图为原始光纤衰减累计统计；红色柱状图为成缆后光纤的衰减，红色线图为成缆后

型值在0.158dB/km，成缆后光纤在1550nm波长处的衰减值较成缆前略高，典型值在0.161dB/km。长飞超低衰减大有有效面积光纤在成缆过程不需要其他特殊设备或特别工艺控制，全部要求同常规G.652光纤成缆要求相同，成缆前后光纤衰减原有衰减在同一水平，没有明显增加。

4. 结论

长飞超低衰减大有有效面积光纤具有超低的衰减系数、较大的有效面积、优异宏弯和微弯性能和良好的成缆适应性，是下一代400G和超400G陆地干线通信系统的最佳选择。

衰减累计统计。从实验我们可以发现，由于长飞公司的光纤在成缆前典

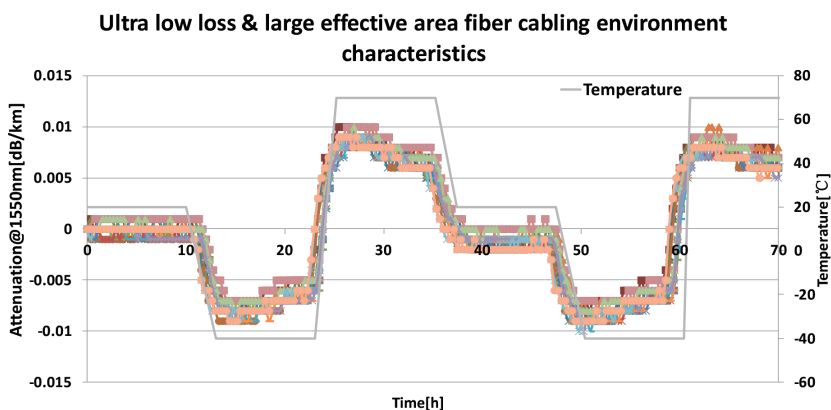


图5 光纤衰减随温度的变化：12个颜色代表12芯光纤的衰减变化

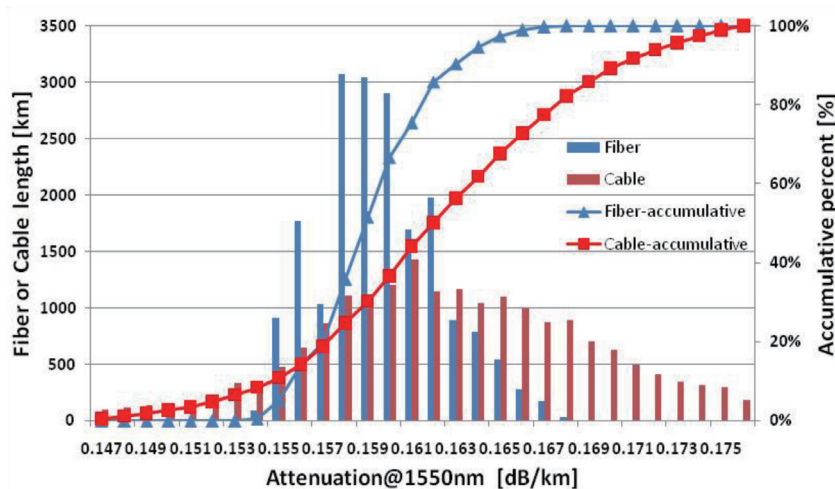


图6 长飞超低衰减大有有效面积光纤产品在成缆前后的衰减对比

New Ultra-Low Loss & Large Effective Area Single-Mode Fibre for Next-Generation Terrestrial Transmission Network

□ Zhang Lei from R&D Center

The standard G.652.D optical fibre are widely deployed in Chinese land trunk network at present, while most of the optical cables laid in the 1990s have reached 20--25 years' service life. With the rapid development of 400G or beyond 400G system, the backbone network optical fibre should be upgraded gradually in the next few years. Therefore, how to choose the right optical fibre for the long-distance terrestrial optical cable is a key problem urgent to be solved to the network operators and optical communication companies. In order to obtain the best system performance, if we can combine the ultra-low attenuation and large effective area characteristics into an optical fibre, such optical fibre will be the best optical fibre in the next-generation communication optical fibre.

1.Latest G.654.E Recommendation

G.654 fibre has widely used in submarine cable since 1990s, its lower loss and larger effective area characteristics are more suitable for next generation 400G system. But submarine cable deployment and application conditions are quite different

to terrestrial cable. So ITU-T decides to make a new subclass for terrestrials G.654 fibre and titled as G.654.E fibre. Table 1 shows the latest ITU-T G.654 specification and YOFC ultra-low loss large effective area optical fibre datasheet. Compared to G.654.B&D, the new G.654.E specification has tightened MFD and dispersion range and pays more attention to macro-bending performance. Due to the complicated deployment condition of terrestrial cable, the macro-bending requirement of G.654.E is as same as G.652.D fibre. As shown in the table1, the ultra-low loss & large effective area optical fibre (FarBand[®] Ultra) of YOFC can meet and even be better than the most existing stringent G.654.E standard recommendation proposals.

2.Design and manufacturing of optical fibre

The sectional structure of optical fibre refractive index is as shown in Diagram 1. YOFC ultra-low loss & large effective area optical fibre used pure silica concept in the manufacturing and compared with the traditional fluorine-doped external cladding structure ULL

fibre, YOFC adopts pure silica (SiO₂) as the optical fibre outer cladding. Due to the reduction in the use amount of fluorine-doped materials, in terms of material preparation cost, preparation technology difficulty, or environmental protection and other points of view, YOFC ultra-low attenuation large effective area optical fibre products are more competitive in the cost.

3.Product performance

3.1Optical fibre attenuation

In terms of theory and practical points of view, the lower attenuation can reduce the number of repeaters and reduce the maintenance costs of long-haul communication network. Therefore the continuous reduction in the optical fibre attenuation is the long-term goal of optical fibre research and development. For optical fibre R&D and manufacturing enterprises, a qualitative and quantitative analysis on various parts composed by the attenuation in theory can effectively help us find the best way to reduce attenuation and guide our work direction in the practical work.

Table 2 shows the specific comparison value for each loss

Table 1. ITU-T G.654 fibre specification and YOFC G.654 series fibre datasheet.

ITEM		ITU-T G.654 Specification			YOFC Farband®Ultra -110	YOFC Farband®Ultra -130
		G.654.B	G.654.D	G.654.E		
MFD@ 1550nm (um)	Nominal	9.5–13.0	11.5–15.0	11.5–12.5	11.2–12.0	12.2–13.0
	Tolerance	±0.7	±0.7	±0.7		
Effective area@ 1550nm (um ²)		\	\	\	110	130
Cable cut-off wavelength (nm)		≤1510	≤1530	≤1530	≤1530	≤1530
Attenuation@1550nm (dB/km)		≤0.22	≤0.20	≤0.23	≤0.17 (Std.)	≤0.17 (Std.)
					≤0.16(LL)	≤0.16(LL)
					≤0.15(ULL)	≤0.15(ULL)
Macro-bending (R30mm×100 turns)	1550nm (dB)	TBD	TBD	TBD	≤0.05	≤0.05
	1625nm (dB)	≤0.5	≤2.0	≤0.1	≤0.1	≤0.1
*Dispersion coefficient @1550nm (ps/nm/km)		≤22	≤23	17–23	17–22	17–23
dispersion slop @1550nm (ps/nm ² /km)		≤0.070	≤0.070	0.050–0.070	0.050–0.070	0.050–0.070
PMD (ps/km ³)		≤0.2	≤0.2	≤0.2	≤0.2	≤0.2
Cladding outer diameter (um)		125±1	125±1	125±1	125±1	125±1
Core cladding concentricity(um)		≤0.8	≤0.8	≤0.8	≤0.8	≤0.8
Cladding circularity (%)		≤2.0	≤2.0	≤2.0	≤1.0	≤1.0

contribution factors of the ultra-low loss and large effective area optical fibre and the standard G.652.D optical fibre's attenuation contribution by different parts at 1550nm. Thanks to the pure silica core design by PCVD process, the Rayleigh scattering can be lower to about 0.12dB/km and YOFC ultra low loss fibre's typical can reach to 01.5dB/km.

3.2 Macro-bending loss

Another factor affecting the use of large effective area optical fibre on land is that the terrestrial cable installation and application environment are more complex than the submarine cable, it often needs to go through some of the corners or needs to leave enough cable or fibre length in the junction box, therefore, the terrestrial optical fibre must be ensured to have better macro-

bending resistance performance than the submarine optical fibre.

The main factor affecting the macro-bending is the profile design of the optical fibre. The depressed trench

structure is the main design scheme used for bend-insensitive G.657 optical fibre, while in our ultra-low loss large effective area optical fibre design, we use a similar structure, which can optimize the volume

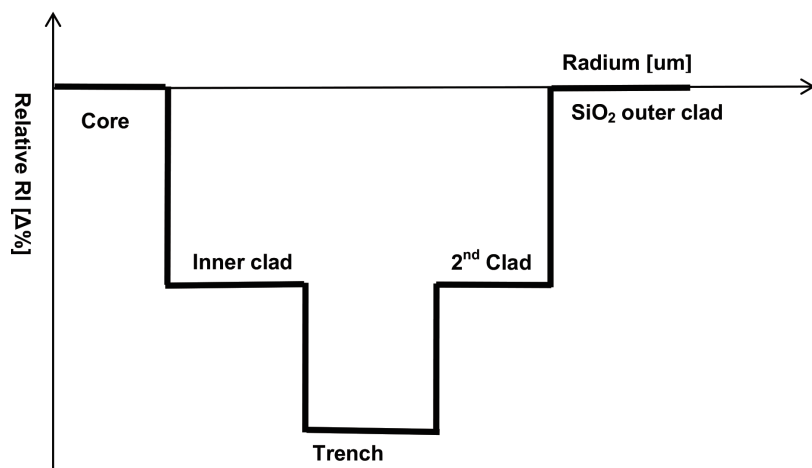


Diagram 1 for optical fibre refractive index profile structure

Table 2 Standard G.652.D and ultra-low attenuation optical fibre attenuation spectral decomposition

	Standard G.652.D	Ultra-low loss & Large Aeff. fibre
Rayleigh scattering contribution	0.162 dB/km	0.127 dB/km
Infrared absorption contribution	0.014 dB/km	0.014 dB/km
Others	0.016 dB/km	0.012 dB/km
Total attenuation	0.192 dB/km	0.153 dB/km

of the depressed trench to a reasonable value in order to obtain a better bending resistance performance. As shown in the following Diagram 2, compared with the standard G.652.D single-mode fibre, our ultra-low loss large effective area optical fibre has more excellent bending insensitive performance; it can fully meet and be better the standard G.657. A1, thereby meeting various harsh and complex environment requirements in the actual deployment of the terrestrial cable application.

3.3 Micro-bending loss

The most worried thing in the industry is the micro-bending performance for the use of the large effective area optical fibre on land. Micro-bending performance is an important factor affecting the cabling design and cabling process, better micro-bending performance can reduce the difficulties in the cabling design and cabling process and improve the performance stability of the optical cable under different application conditions, especially in extreme environments. But the current mainstream methods for increasing the effective area of the optical fibre is to increase the fibre core layer diameter or reduce the fibre core layer relative refractive index, both designs will have a negative effect on the micro-bending of the optical fibre. While the ultra-low loss large effective area optical fibre of YOFC Company has effectively reduced the micro-bending loss of the ultra-low

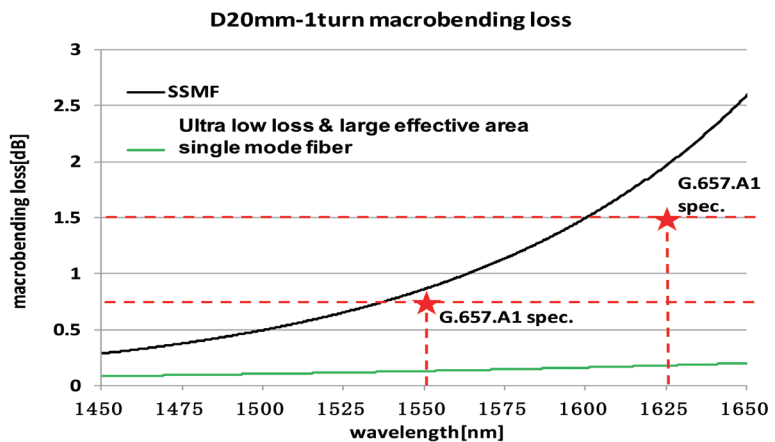


Diagram 2 Comparison of macro-bending loss

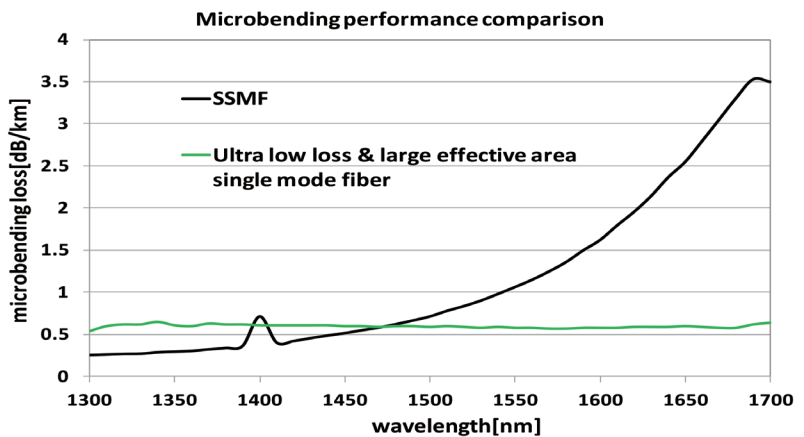


Diagram 3 Comparison of micro-bending losses between the ultra-low loss large effective area optical fibre and the standard G652 optical fibre

loss large effective area optical fibre by using the specially optimized and designed depressed trench structure design and combining with the special optical fibre coating process. Diagram 3 shows the comparison of the micro-bending performances between

YOFC's ultra-low loss optical fibre with an effective area of $110\mu\text{m}^2$ and the standard G.652.D single-mode fibre, it can be seen that YOFC optical fibre has excellent micro-bending performance and its typical micro-bending loss is less than 0.5dB / km in the whole

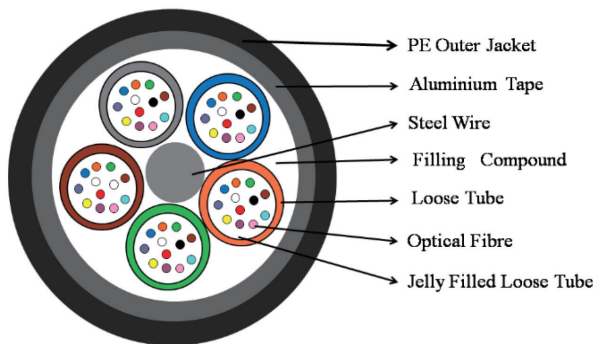


Diagram 4 the schematic diagram for optical cable structure

wavelength range.

3.4 Optical cable TCT performance

As discussed above, since the application environment of the terrestrial optical cable is more complex and harsh than the environment of the submarine optical cable, the terrestrials optical cable needs to keep the link loss stability even under the more fierce temperature change conditions. To further validate the performance of YOFC's optical fibre after cabling, we have performed the relevant cabling experiments. In the summary of the relevant standards, the optical fibre temperature cycle test is commonly used to detect the changes in loss with temperature. In the experiment, we placed 12-core ultra-low loss large effective area (110 μm^2) optical fibre in an optical cable pipe of a GYTA for TCT experiment; Diagram 4 shows the schematic diagram for our optical cable structure.

We can see from Diagram 5 that when the temperature changes in the range of -40 degrees Celsius to +70 degrees Celsius, the loss changes of our ultra-low loss large effective area (110 μm^2) optical cable will be less than 0.01dB / km and far superior to 0.05dB / km specified by the IEC and ITU-T standards.

3.5 Loss changes during the cabling

In 2016, YOFC provided about

21,000Fkm Farband@Ultra-110 fibre to China Mobile. Diagram 6 shows the loss changes for YOFC ultra-low loss large effective area optical fibre before/after the cabling. The blue bar is fibre loss distribution before cabling and the blue line is the low accumulative data of the fibre; the red bar

is the loss distribution after cabling and the red line is the low accumulative data of the cable. The typical loss of YOFC optical fibre before cabling is about 0.158dB/km, while the cables' typical loss is about 0.161dB/km. In this project, we use the G.652.D technical setting during the cabling and the ultra- low loss & large effective fibre is stable during the cabling.

4. Conclusions

The ultra-low loss and large effective area of YOFC optical fibre has super low loss coefficient, larger effective area, excellent macro-bending and micro-bending performance as well as excellent adaptability of deployment and is the best choice of the next generation 400G and super 400G terrestrial communication system.

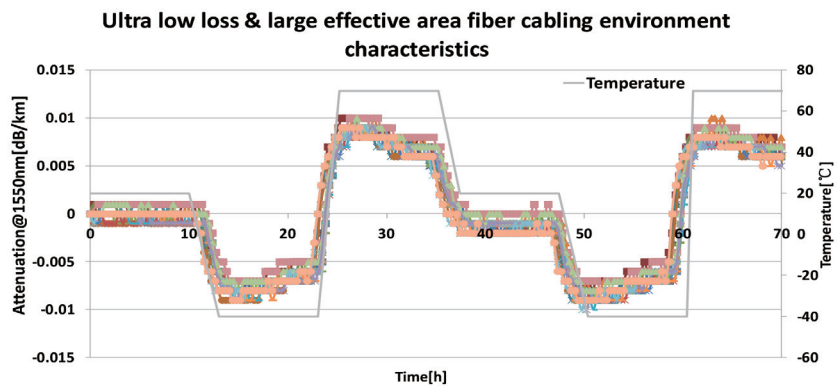


Diagram 5 Changes in the optical fibre loss with temperature: 12 colors represent the loss changes of 12-core optical fibre

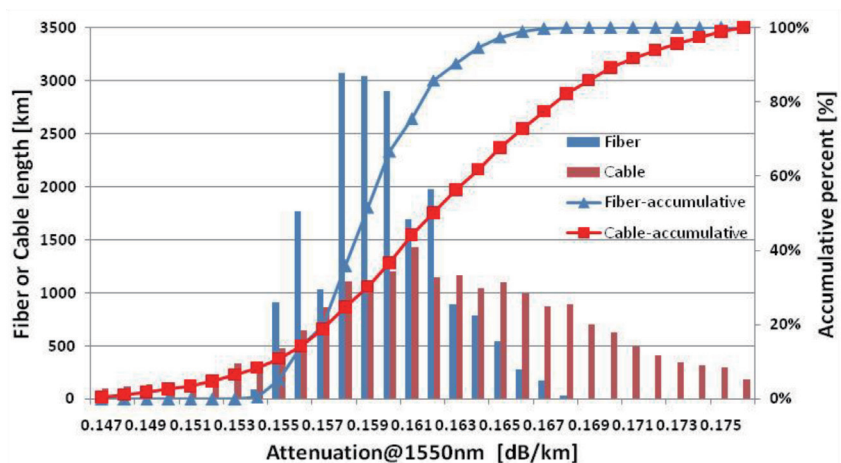


Diagram 6 G.654.E fibre loss changes before/after the cabling



用于高速 SWDM 系统的 OM5 多模光纤

□ 研发中心 黄荣

服务器虚拟化、云计算和高速端口等应用正在将数据中心的网络速度推向100Gbps，并最终将达到400Gbps。短波波分复用技术（SWDM）是一项可以提高多模光纤传输容量的极具前

景的技术。2016年6月，通信工业协会（TIA）发布了一种新型宽带多模光纤的TIA-492AAAE标准，该光纤采用垂直腔面发射激光器（VCSEL），工作窗口为850nm到950nm，支持4波长

SWDM技术。此外，在即将推出的ISO/IEC 11801第三版标准中，将以OM5为宽带多模光纤命名。SWDM4技术可以节省四倍的光纤数量，在100Gbps链路中可以将光纤数量从8根减少到2根，在400Gbps链路甚至可以将32根节省至8根。宽带多模光纤需要在850nm到950nm的宽波长范围内均具有较高的有效模式带宽（EMB）性能。这种新型光纤扩展了多模光纤的优势，使其在全球高效互联的建筑物以及数据中心内得以广泛应用。

本文中，我们介绍了关于新型弯曲不敏感宽带多模光纤（OM5）的设计、制造和表征结果。在OM5和OM4光纤上也进行了100Gbps的SWDM4传输对比测试。传输测试结果表明，在SWDM系统从100Gbps到400Gbps的发展过程中，OM5光纤具有很大的应用前景。

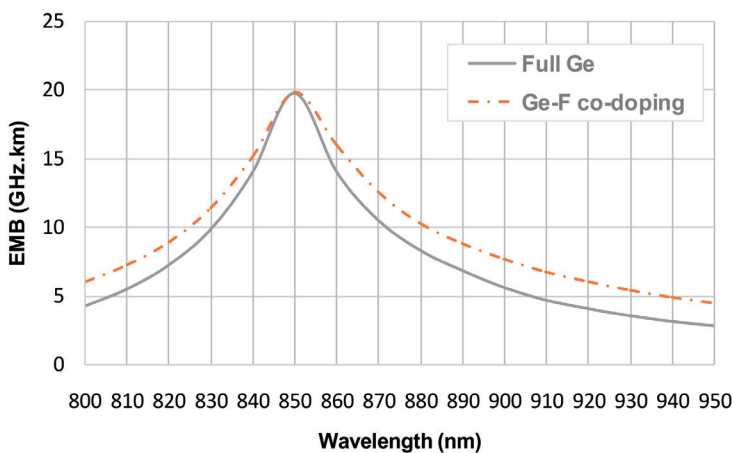


图1 芯层材料组分不同的多模光纤的理论 EMB 与波长的关系

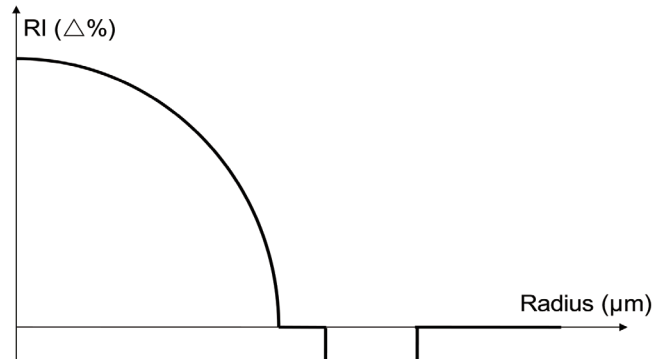


图2 宽带多模光纤的折射率剖面示意图

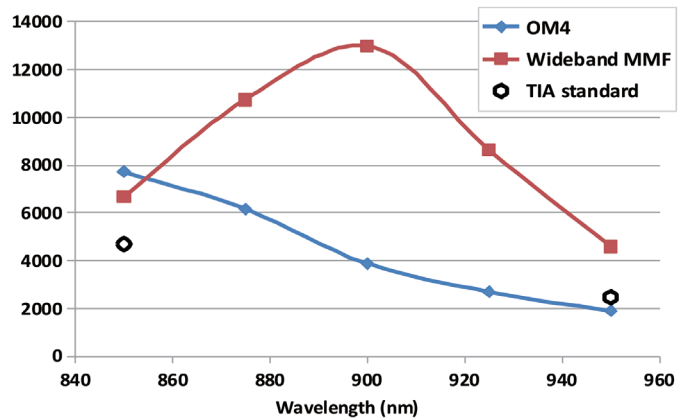


图3 实测不同波长下宽带多模光纤与 OM4 光纤的有效模式带宽

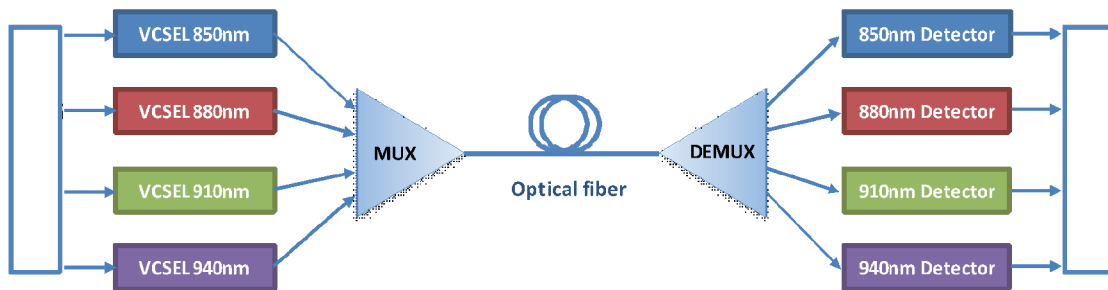


图4 100GE SWDM4 光模块的示意图

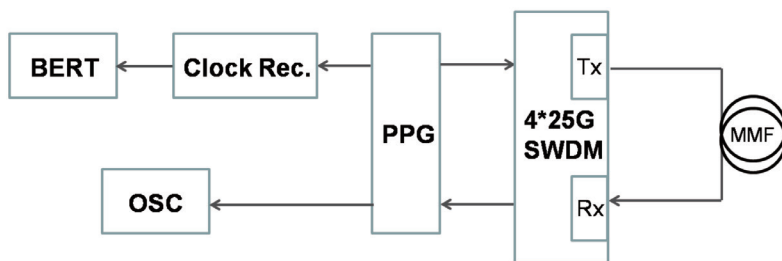


图5 传输实验装置示意图

1. 宽带多模光纤的标准

TIA-492AAAE标准对可支持短波分复用技术的宽带多模光纤进行了规范。该标准兼顾了电气和电子工程师协会 (IEEE) 的100GBASE-SR4模型和32G光纤通道模型, 规定宽带多模光纤在850nm处的有效模式带宽不低于4700MHz·km, 同时在953nm的有效

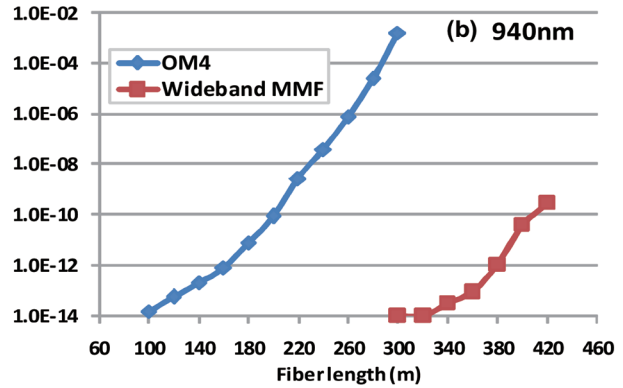
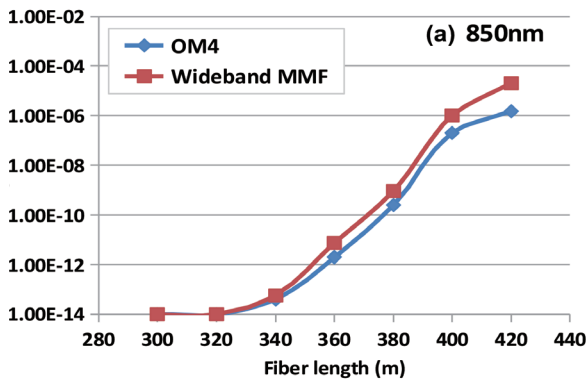


图 6 在 (a) 850 nm 和 (b) 940 nm 传输试验中宽带多模光纤和 OM4 光纤的 BER 与光纤长度的关系曲线

模式带宽不低于2470MHz·km。满足上述带宽要求，宽带多模光纤能够在850nm到950nm的范围内，支持四个速度超过25Gb/s的SWDM4信道，实现至少150米的链路传输。

此外，宽带多模光纤还要求具有较小的宏弯损耗，以7.5mm为半径绕2圈后，其在850nm处的宏弯损耗要求不大于0.2dB，1300nm处的宏弯损耗要求不大于0.5dB。

2. 宽带多模光纤的设计与制备

OM4多模光纤仅专注于850nm附近的窄波长范围，以实现该范围内的高带宽性能。它不支持在4个波长通道都保持较高的带宽性能。我们的研究表明，通过优化光纤芯层的材料组分，可

以降低带宽对波长的敏感性，增大高带宽的波长范围。按惯例，光纤芯层中主要掺杂锗，以实现正的渐变折射率。另外，芯层除了掺杂了锗外，还掺杂了一定浓度的氟。图1显示的是光纤芯层中全锗掺杂和锗-氟共掺的多模光纤的EMB性能的计算结果。计算时还考虑了 α 值，以保证该折射率剖面在850nm处带宽最高。

宽带多模光纤可以通过等离子体化学气相沉积（PCVD）工艺制得，该工艺能够精细控制锗和氟的共掺。图2为制得的宽带多模光纤的折射率剖面示意图。包层中合理设计的下陷结构使光纤具有优异的弯曲不敏感性。

3. 宽带多模光纤的性能表征

光纤的有效模式带宽（EMB）是由一台高精度DMD测量设备测得，所用光源是波长可调节的钛蓝宝石激光器。图3显示了制备的宽带多模光纤和与OM4光纤在850nm到950nm的有效模式带宽性能。较长波长下OM4光纤的带宽性能急剧下降，阻碍了OM4光纤在SWDM4系统中的应用。

为了对比宽带多模光纤和传统的OM4光纤的传输性能，我们采用Finisar的100GE SWDM4光模块测试了其误码率（BER）与光纤长度的关系。图4是Finisar 100GE SWDM4光模块的示意图。收发器分别在850nm、880nm、910nm和940nm处传输4个25Gbps的数据流。

实验装置如图5所示。脉冲模式发生器（PPG）生成信号，经过Finisar的100GE SWDM4光模块处理，然后

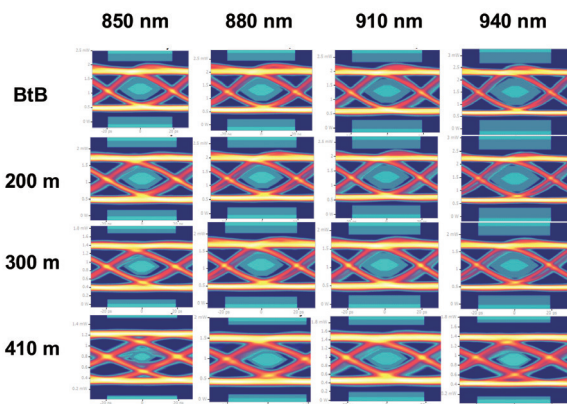


图 7 100Gbps SWDM4 传输实验中不同长度的宽带多模光纤的光眼图

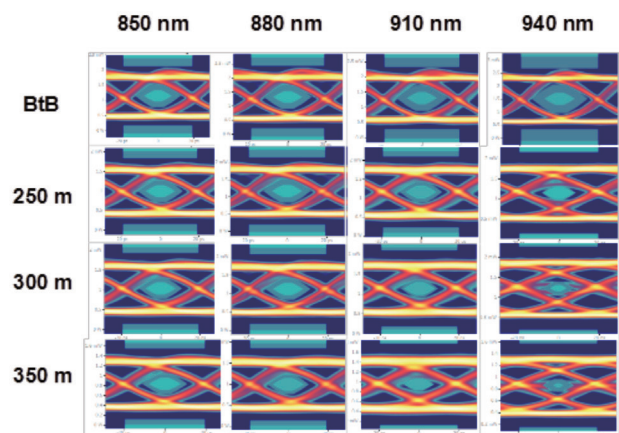


图 8 100Gbps SWDM4 传输实验中不同长度的 OM4 光纤的光眼图

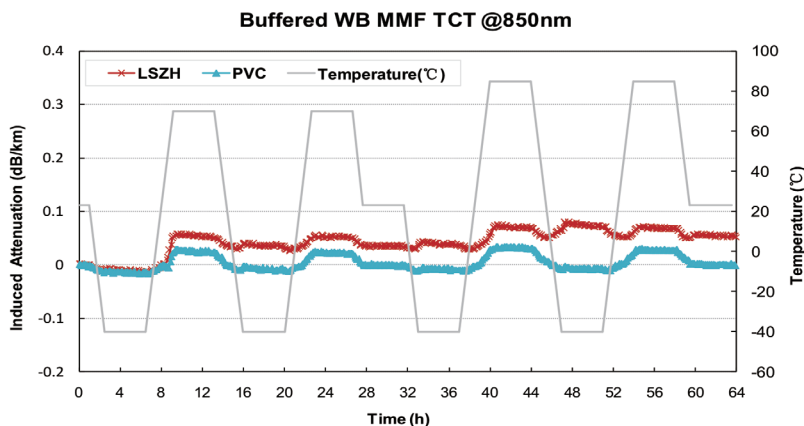


图9 不同包覆材料的宽带多模光纤在850nm温度循环试验结果

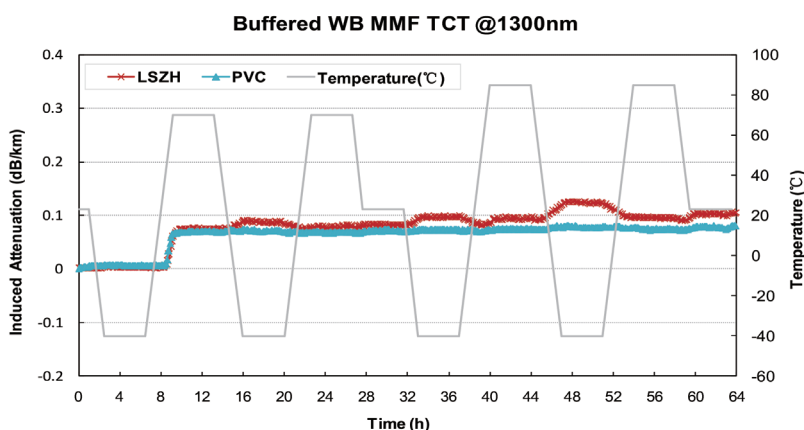


图10 不同缓冲材料的宽带多模光纤在1300nm温度循环试验结果

不同长度的宽带多模光纤和OM4光纤的光眼图分别如图7和图8所示。在所有波长范围内，宽带多模光纤传输300m后的眼图仍然是张开的。与之相比，OM4光纤传输300m后的眼图几乎闭合。

宽带多模光纤通常应用于要经受不同温度变化的紧套光缆中，如数据中心。宽带多模光纤被制作成两种不同包覆材料的紧套缆，低烟无卤（LSZH）和聚氯乙烯（PVC）包覆材料，测试其衰减随温度的变化。图9和图10分别显示了其在850nm和1300nm的温度循环测试结果。其它主要性能参数如表所示。

OM5光纤和SWDM技术具有更高的传输速率、更长的传输距离、更少的光纤数量和更低的布线成本。不仅是当前正在建设的100G数据中心，还是下一代要升级到200G、400G甚至更高传输速度的数据中心，OM5光纤和SWDM技术都可以提供低成本、低能耗、高性能和完美兼容的高品质解决方案。

通过宽带多模光纤样品进行传输，最后被误码率测试仪（BERT）和示波器（OSC）接收并观察电子眼图。在误码率测试前，需要进行时钟恢复。需要注意的是光眼图是信号从光纤输出时直接得出的，并没有经过SWDM4模块的接收端。

如图6所示，在没有前向纠错（FEC）技术的情况下，宽带多模光纤和OM4光纤都能在850nm实现340m以下的无误码传输（BER < 1E-12）。然而，在940nm处，OM4光纤的传输距离急剧下降，而宽带多模光纤在340m以内依然能够保持无误码传输。因此，我们制备的宽带多模光纤可以实现超过300m的100Gbps传输，远大于标准要求的150m。

100Gbps的SWDM4传输实验中

表 制得的宽带多模光纤的主要性能参数

数值孔径	@850nm	0.198
芯径 (μm)	@850nm	49.8
衰减 (dB/km)	@850nm	2.25
	@950nm	1.54
	@1300nm	0.44
有效模式带宽 (MHz·km)	@850nm	6658
	@875nm	10745
	@900nm	12984
	@925nm	8626
	@950nm	4577
色散 (ps/nm/km)	@850nm	-95
	@950nm	-59
15mm半径2圈的宏弯损耗 (dB)	@850nm	0.008
	@1300nm	0.041
7.5mm半径2圈的宏弯损耗 (dB)	@850nm	0.065
	@1300nm	0.207



OM5 Multimode Fiber for High Speed SWDM Systems

□ Huang Rong from R&D Center

Server virtualization, cloud computing, and higher speed ports are now driving network to 100 Gbps and eventually 400 Gbps in data centers. Short Wavelength Division Multiplexing (SWDM) is a promising technique to increase the transmission capacity of multimode fibers. In June 2016, the Telecommunications Industry Association (TIA) issued a standard of a new type of multimode fiber named Wideband, which targets an operational window between 850 nm and 950 nm with Vertical Cavity Surface Emitting Lasers (VCSELs) to support 4 wavelengths SWDM in TIA-492AAAE. Besides, OM5 was chosen as the official designation for cabling containing

Wideband Multimode Fiber in the upcoming third edition of ISO/IEC 11801. SWDM4 technology saves four times the amount of optical fibers, reducing fiber

counts from 8 to 2 for 100 Gbps and even from 32 to 8 for 400 Gbps links. The wideband multimode fibers are required to have high effective modal

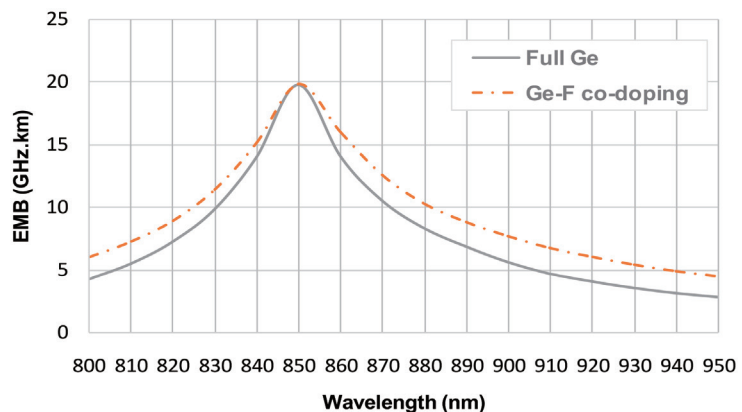


Figure 1. Computed EMB of multimode fibers with different core material compositions versus wavelength

bandwidth (EMB) performance over a wide range of wavelengths from 850 nm to 950 nm. This novel optical fiber extends the benefits of multimode fiber within connected and efficient buildings and within data centers worldwide.

In this paper, we present our work on the design, fabrication and characterization of the novel bend-insensitive Wideband Multimode Fibers (OM5). 100 Gbps SWDM4 transmission tests were also carried out over OM5 and OM4 fibers. The transmission testing results show that OM5 fibers have a great potential application in the evolution of SWDM systems from 100 Gbps to 400 Gbps.

1. Requirements for Wideband MMF

The wideband multimode fiber is specified in TIA-492AAAE, taking the both Excel link models for IEEE 100GBASE-SR4 and Fibre Channel 32GFC into account, that the EMB minimum values are 4700 MHz · km

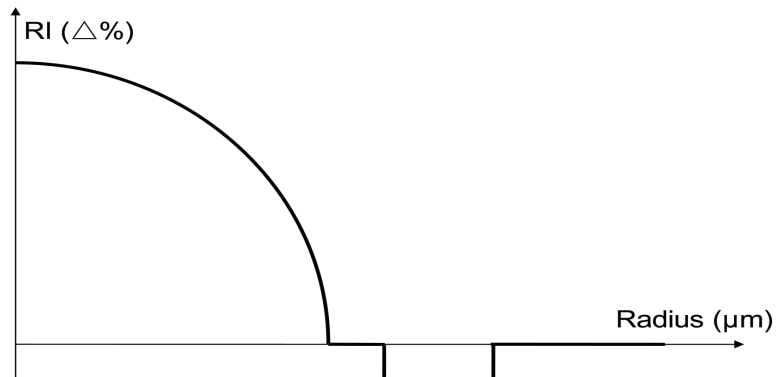


Figure 2. Schematic of WB MMF refractive index profile

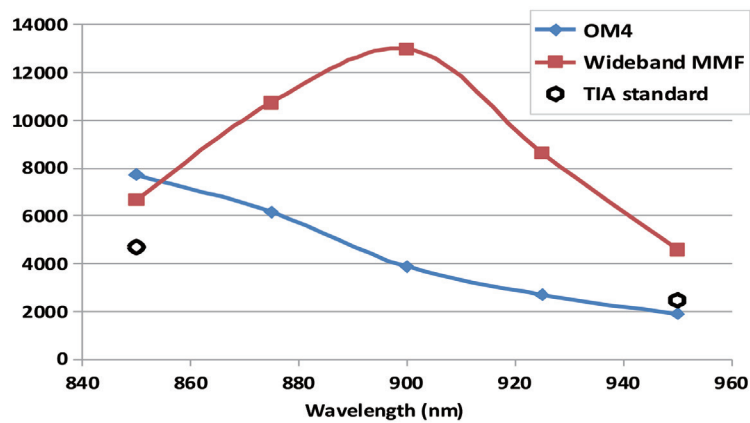


Figure 3. Tested EMB of Wideband MMF and OM4 fiber versus wavelength

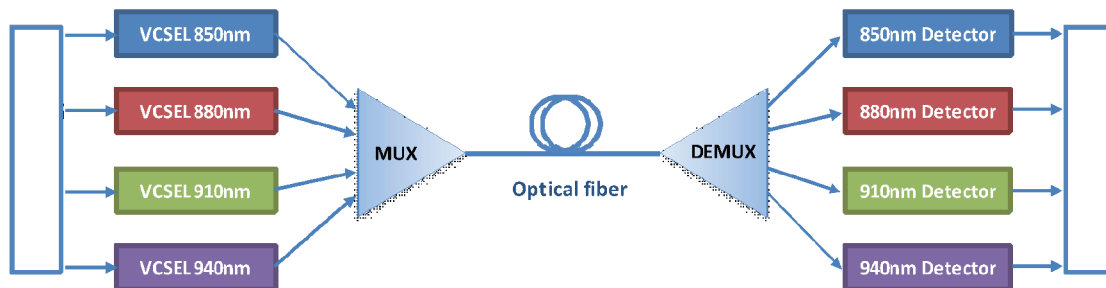


Figure 4. Schematic of the 100G SWDM4 transmission

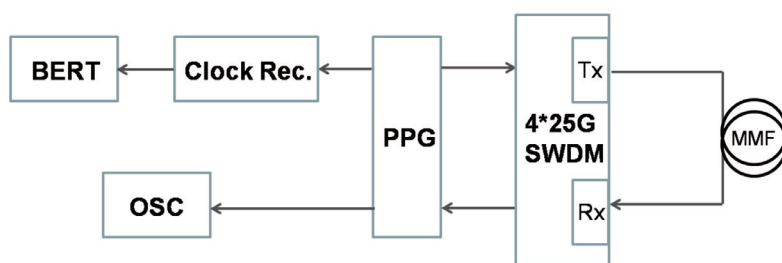


Figure 5. Overview of the experimental setup

at 850 nm and 2470 MHz · km at 953 nm. With these bandwidth requirements fulfilled, the Wideband MMF is able to support four SWDM channels between 850 nm and 950 nm at speeds of over 25 Gb/s to realize a 150 meters transmission link at least.

Besides, the Wideband MMF is required to have a small macro-bending loss, less than 0.2 dB at 850 nm and 0.5

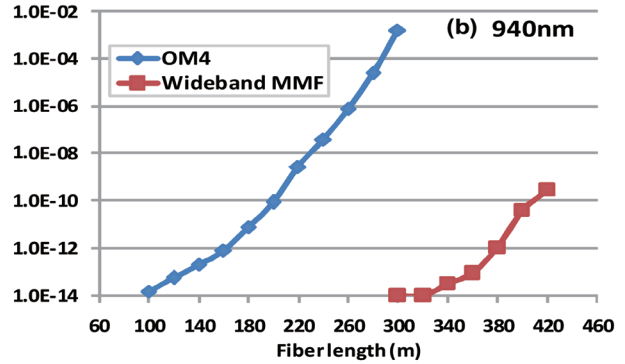
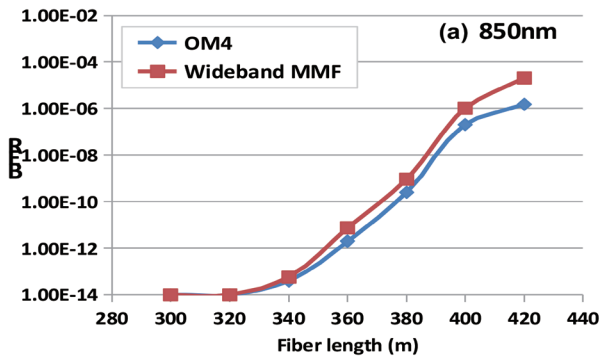


Figure 6. BER curves of Wideband MMF and OM4 fiber as a function of fiber length at (a) 850 nm and (b) 940 nm

dB at 1300 nm with 2 turns at bending radius of 7.5 mm.

2. Wideband MMF design and fabrication

OM4 multimode fibers only focus on a narrow wavelength range near 850 nm to achieve high EMB performance. It cannot support 4 wavelength channels to maintain maximum reach. It is shown in our research that, wavelength range of fibers with high EMB performance can be broadened by optimizing the composition of the doping materials in fiber core. Conventionally, there is mainly Germanium doped in multimode fiber core to obtain a positive graded refractive index. Herein, Fluorine is adopted additionally doping in fiber core with certain concentration. Figure 1 presents the computed results of EMB performance of multimode fibers with full

Germanium and Germanium-Fluorine co-doping in fiber cores. And the alpha values were taken into account to keep the refractive index profiles with best bandwidth at 850 nm.

WB MMF can be fabricated via the plasma chemical vapor deposition (PCVD) process that can realize elaborated co-doping of Germanium and Fluorine. Figure 2 shows the schematic refractive index profile of a WB MMF. The trench structure design in fiber cladding helps the fiber get an excellent bend insensitive performance.

3. Wideband MMF characterization

The EMB performance is measured using a high resolution DMD bench with a tunable Titanium-Sapphire laser at various wavelengths. Figure 3 shows the EMB performance of The

fabricated Wideband MMF and OM4 fiber over wavelengths from 850 nm to 950 nm. The sharp decline of EMB performance at longer wavelengths hinders the OM4 fiber to apply in the SWDM4 system.

In order to compare the transmission performance of Wideband MMF and OM4 fiber, we measured bit error rate (BER) curves as a function of the fiber length using a Finisar 100GE SWDM4 optical module. Figure 4 is a schematic of the Finisar 100GE SWDM4 optical module function. The transceivers transmit four streams of 25 Gbps data at the wavelengths of around 850, 880, 910 and 940 nm.

The overall experimental setup is shown in Figure 5. Signals generated by a pulse pattern generator (PPG) were processed by the Finisar 100GE SWDM4 optical module, then transmitted by the multimode fiber samples, finally

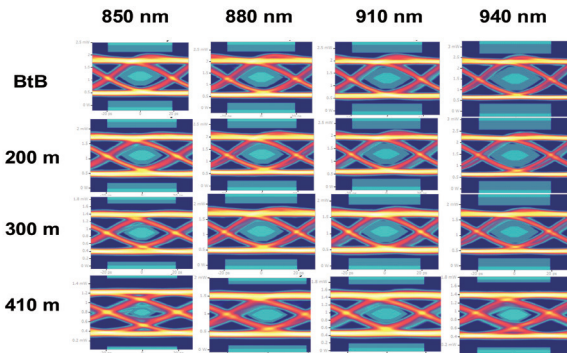


Figure 7. Optical eyes of the 100G SWDM4 transmission over Wideband MMF at various lengths

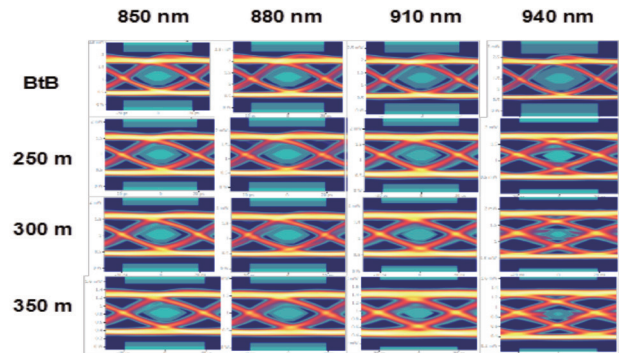


Figure 8. Optical eyes of the 100G SWDM4 transmission over OM4 fibers at various lengths

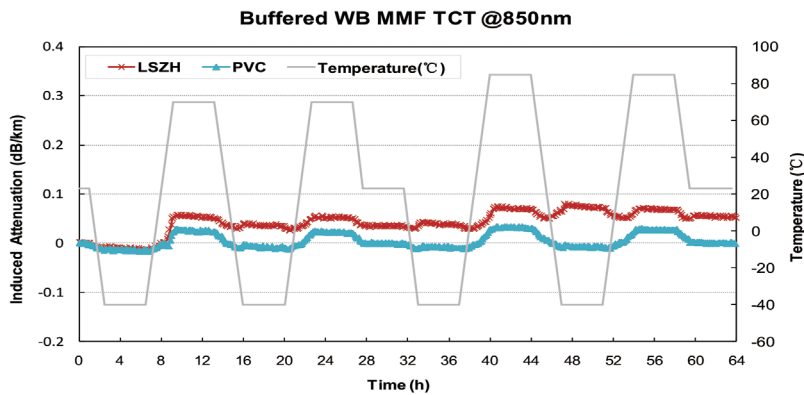


Figure 9. Temperature cycling test of fabricated WB MMF with different buffered materials at 850 nm

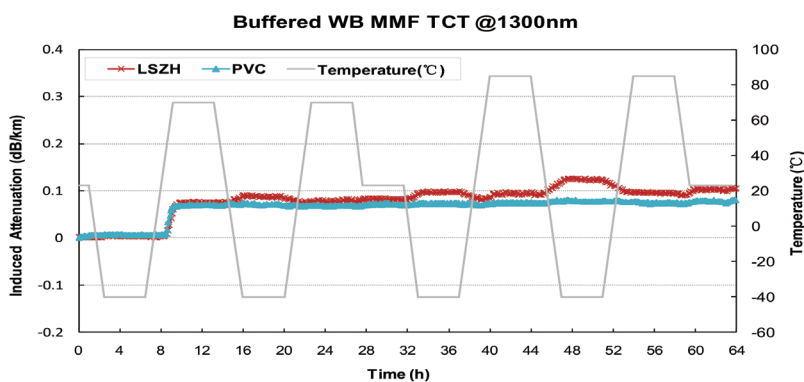


Figure 10. Temperature cycling test of fabricated WB MMF with different buffered materials at 1300 nm

received by a bit error rate tester (BERT) and an oscilloscope (OSC) to observe the electrical eye diagrams. A clock recovery was used before bit error rate testing. It should be noted that the optical eye diagrams were obtained at the fibers output directly, not through the Rx of the SWDM4 optical module.

Figure 6 reveals that, without forward error correction (FEC) technology, both the Wideband MMF and OM4 fiber can achieve error free operation ($BER < 1E-12$) at the length below 340 meters at 850 nm. However, at 940 nm, the OM4 fiber transmission distance drops sharply, while the Wideband MMF still maintains a low BER below 340 meters. The fabricated Wideband MMF can support a distance of over 300 meters in 100 Gbps transmission, which is far exceeding the standard requirements of 150 meters.

Optical eyes of the 100 Gbps SWDM4 transmission over Wideband MMF and OM4 fibers are displayed

in Figure 7 and 8, respectively. The Wideband MMF provided open eyes at all wavelengths after 300 meters, while the eye was almost closed after 300 meters of OM4 fiber.

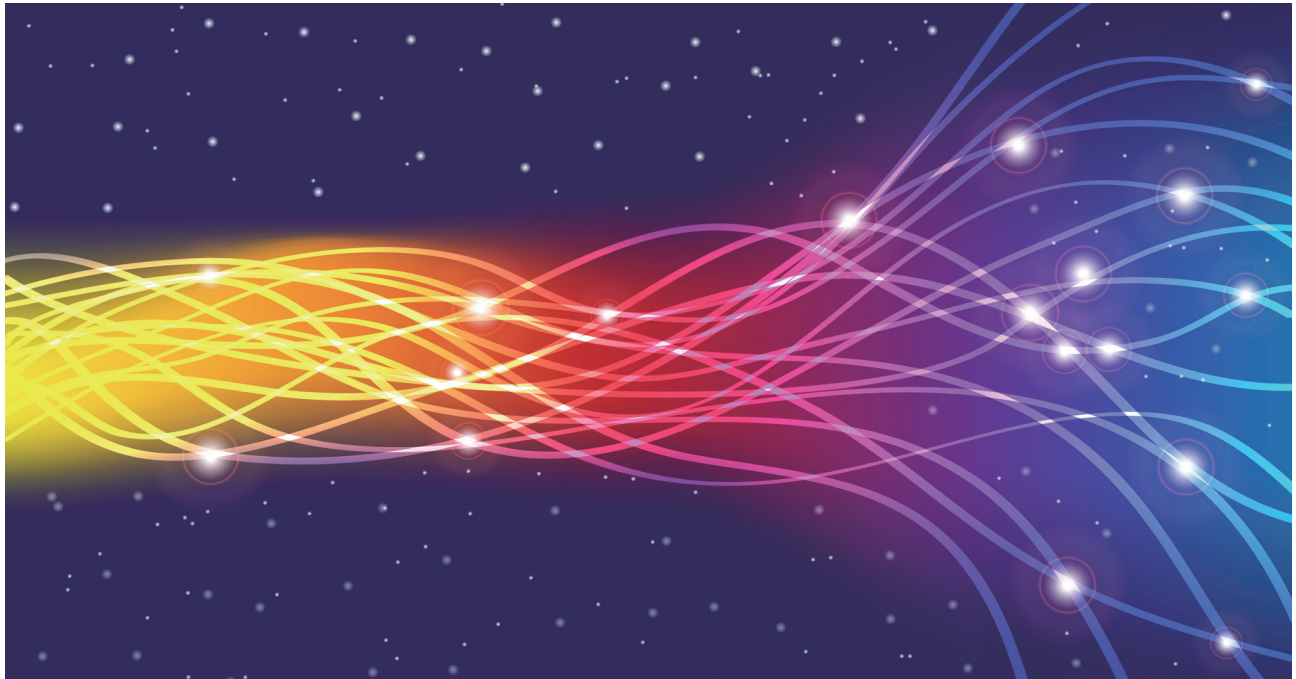
Wideband multimode fibers are usually applied in buffered fibers subjected to different temperature changes, such as in data centers. The fabricated Wideband multimode fibers has been coated with low smoke zero halogen (LSZH) and Polyvinylchloride (PVC) buffered materials respectively to test the attenuation change with temperature. Temperature cycling test results at 850 nm and 1300 nm are shown in Figure 9 and 10, respectively. Other fiber characteristics are listed in Table .

OM5 fibers and SWDM technology have higher transmission rates, longer transmission distances, fewer fiber amounts, and lower wiring costs. Not only for current urgent 100G data center construction, OM5 fibers and SWDM technology provide a low cost, low energy consumption, high performance, perfect compatibility of high quality solutions, they are also for the next generation of data center upgrade to 200G, 400G or even higher speed.

Numerical aperture	@850nm	0.198
Core diameter (μm)	@850nm	49.8
Attenuation (dB/km)	@850nm	2.25
	@950nm	1.54
	@1300nm	0.44
Effective modal bandwidth (MHz · km)	@850nm	6658
	@875nm	10745
	@900nm	12984
	@925nm	8626
	@950nm	4577
Chromatic dispersion (ps/nm/km)	@850nm	-95
	@950nm	-59
Macrobend loss with 2 turns on 15mm radius (dB)	@850nm	0.008
	@1300nm	0.041
Macrobend loss with 2 turns on 7.5mm radius (dB)	@850nm	0.065
	@1300nm	0.207

光纤激光器中 用双包层掺镜光纤

□ 特种产品事业部 杨玉诚



得益于材料加工行业的快速发展及逐渐成熟，工业激光器在全球激光器市场份额持续增长，其中光纤激光

器表现尤为亮眼，国内光纤激光器市场增长也十分迅猛。据统计，2016年国内光纤激光器产能达7.4万台，主要

由近6万台小功率光纤激光器、1.2万台中功率光纤激光器和超过2000台的高功率光纤激光构成。

表 1 125 μm 大模场双包层掺镜光纤 (LMA DC YDF) 参数

参数	10/125	20/125
纤芯直径(μm)	10	20
纤芯NA	0.08 \pm 0.05	0.08 \pm 0.05
包层直径(μm)	125	125
包层形状	八边形	八边形
包层吸收系数(dB/m)	1.6 \pm 0.3	3.6 \pm 0.4
斜率效率	>75%	>70%
包层NA	>0.46	>0.46

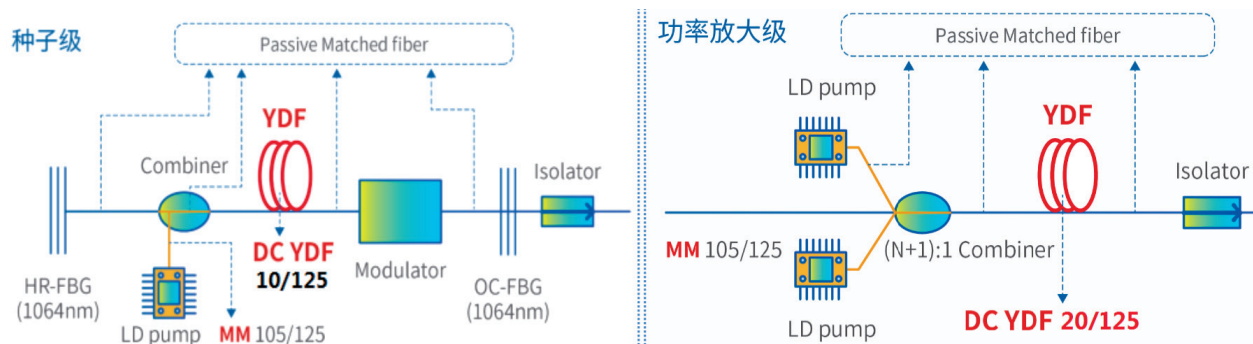


图1 长飞公司低功率有源及无源解决方案

光纤激光器系统中，有源光纤和无源光纤、激光二极管以及各种光纤器件的逐渐成熟和日臻进步，使得光纤激光器和放大器得到巨大发展。基于双包层掺镱光纤，尤其是大模场双包层掺镱光纤(LMA DC-YDF)和匹配的大模场双包层无源光纤(LMA DC-GDF)的性能特点，光纤激光器展现出高输出功率(高峰值、高平均功率)、优异光束质量优势、集成化、成本低等优点。

近年来国产光纤激光器表现抢眼，但多集中在中低功率领域。据有关数据统计，国产光纤激光器在中小功率的出货量占比超过92%。在高功率应用方面，国外企业依旧占据主导地位。虽然国内企业依靠泵浦封装、泵浦合束器、能量合束器、隔离器、光纤光栅、激光传输组件等器件的国产化，取得了长足进步，逐步摆脱了对国外企业的依赖，但在某些关键器

件技术及品质方面仍有很大差距，如泵源芯片、匹配的大模场双包层无源光纤和大模场双包层掺镱光纤在全功率段都没有实现国产化量产。现光纤激光器厂家大都使用进口大双包层掺镱光纤并配套同样进口的大包层无源光纤，这表明光纤激光器核心原材料并未实现国产化。同时严格的验证标准和超长的验证周期，进一步导致激光器用光纤产品迭代改进的速度落后。由此可见，双包层掺镱光纤及双包层无源光纤国产化是制约国内光纤激光器发展的重要原因。因此，国产化任务至关重要，刻不容缓。

长飞公司经过五年的技术积淀、平台打造和产品系列化研发，已逐步推出了定位于低功率光纤激光器的125 μm系列大模场双包层掺镱光纤和定位于中高功率光纤激光器的20/400系列双包层掺镱光纤。

长飞公司通过MCVD平台，在国内首次采用CDS聚合物和铝磷镱三元掺杂工艺，很好地优化了掺镱光纤的光子暗化性能及耐高功率冲击性能。同时借助多年的工艺技术沉淀，长飞公司已建立成熟的大棒工艺路线，该路线不仅极大地提高了单棒产能，更提高了光纤的批次一致性和几何均匀性。

125 μm大模场双包层掺镱光纤包含10/125和20/125两种型号，如表1所示。

125 μm系列大模场双包层掺镱光纤主要针对典型MOPA及调Q类型20W光纤激光打标市场。其中DC-10/125YDF的高吸收系数(>1.6dB/m@915nm)和大于60%的光光转换效率，能够保持一级使用长度在4米左右。MOPA型光纤打标机能显著降低光纤的使用长度，节省成本。并且该光纤在915nm附近的平坦吸收峰能降

表2 大模场双包层 20/400 掺镱光纤参数

参数	20/400
纤芯直径(μm)	20.0±2.0
纤芯NA	0.065±0.05
包层直径(μm)	400±5
包层形状	八边形
包层吸收系数(dB/m)	0.39±0.3
包层NA	>0.46
光-光转换效率(915nm)	>65%

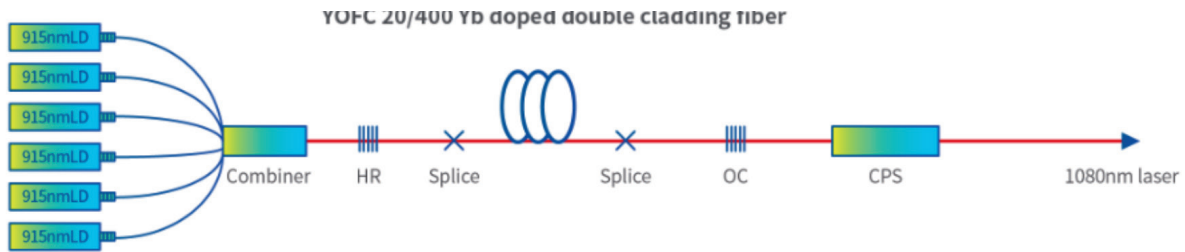


图2 高功率20/400光纤激光器原理图

低激光器系统对冷却的设计要求。而调Q型光纤打标机能降低一级谐振腔长，降低腔内损耗，压缩脉宽，提高二级脉宽的展宽冗余量，是提高打标质量的可靠保证。长飞公司低功率有源及无源解决方案如图1所示。

激光器使用长飞的双包层10/125和20/125掺镱光纤，功率输出可控制在19w至21w之间，脉宽可控制在90-110ns之间；同时，由于长飞20/125的DC-YDF采用了大模场设计，20μm的纤芯掺杂经过优化设计后，光纤激光器能保持近M2<1.5的激光光束输出。

长飞公司使用优化后的光纤拉丝工艺，光纤在环境稳定性方面有明显改进，尤其是通过了严苛的高温高湿环境的快速老化验证：光纤经过24小时、125℃、2个大气压的老化后，玻璃包层与内涂层之间依然保持一致的剥离力；在激光器厂商500小时连续烤机验证过程中，使用长飞公司光纤

的光纤激光器的功率输出波动在5%以内；使用长飞125μm系列掺镱包层掺镱光纤在经过85℃/85%RH条件老化后，功率波动保持在3%以内，同时二级输出仍能保持较好的光束质量。

针对应用于连续中高功率激光器300W-1500W的关键光纤原材料，长飞推出了大模场双包层20/400掺镱光纤，指标如表2所示。

中高功率连续激光器的成本主要集中在泵源总功率和热管理部分，长飞公司生产的有源光纤有着较高的转换效率，能减少泵源的功率输出，降低泵源的热管理难度。同时更高的转换效率能降低光纤产生的热量，大大减缓由于严重发热造成的光纤涂层的老化速度，提高光纤乃至整机寿命，保持功率更长时间的稳定输出。

高功率20/400光纤激光器原理图如图2所示，915nm的泵浦光耦合使用1080nm的高低反光栅进行测试，长飞公司大模场双包层20/400掺镱光纤的

光光转换效率达到67%，同时随着泵浦功率的增加，光光效率呈现出增加的现象。（见图3测试结果）

为验证长飞20/400光纤更高功率的稳定性，测试人员增加了一组1400W的稳定性测试实验。测试结果显示，长飞20/400光纤1小时内功率波动值在0.21%，如图4所示。

综上所述，长飞针对低功率打标用光纤激光器应用推出的125μm系列两款双包层掺镱光纤(10/125和20/125)，在高温高湿环境下涂层与玻璃包层的结合紧密，保证了长期的工作可靠性；双包层20/400掺镱光纤在中功率的转换效率达到67%，1400w输出的功率波动极其稳定。

长飞公司着眼未来光纤激光器市场，基于对光纤激光器及其应用的深刻理解，充分利用长飞公司特种光纤的开发生产平台、技术能力与悠久的工艺沉淀，努力为行业提供国产化的优质特种光纤！

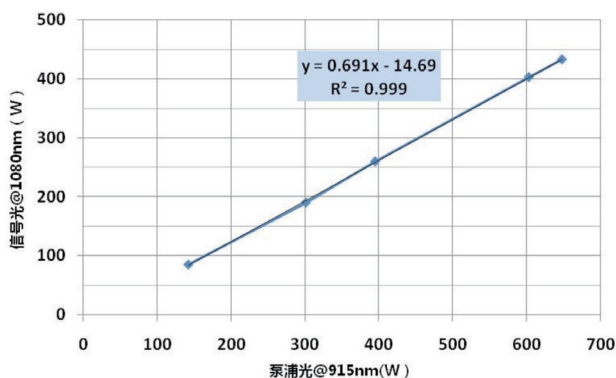


图3 915nm 泵浦光光转换效率测试结果

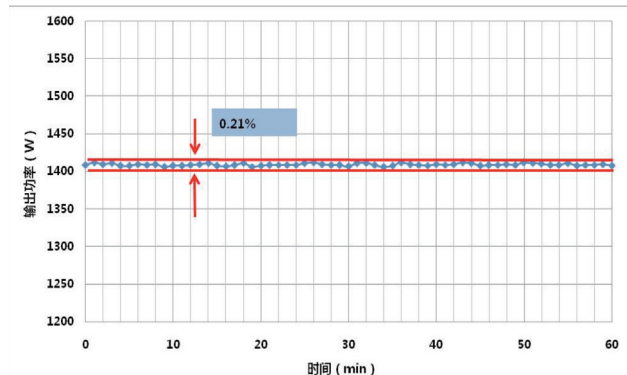


图4 1400W 连续1小时功率测试



Double-cladding Yb Doped Fibre In fibre Laser

□ Yang Yucheng from Specialty Products Business Unit

Thanks to the rapid development and mature of materials processing industry, industrial laser continues to grow in the global market share of laser, highlighting the fibre lasers. Furthermore, the fibre laser is also growing rapidly in the domestic market. The statistics shows that the fibre laser production capacity has reached 74,000 sets in 2016, among which 60,000 sets of low-power fibre lasers, 12,000 sets of power fibre lasers and over 2,000 sets high-power fibre laser.

In terms of fibre laser system, the development of active fibre and passive fibre, laser diodes and a variety of fibre optic devices becomes mature gradually, significantly contributing to the development of fibre lasers and amplifiers. The fibre laser, based on the performance characteristics of double-cladding Yb

doped fibre, especially the larger-mode-area double-cladding Yb doped fibre (LMA DC-YDF) and matched larger-mode-area double-cladding passive fibre (LMA DC-GDF), features excellent advantages in terms of high output power (high peak, high average power), beam quality, integration and low cost.

In recent years, the domestic fibre laser is outstanding performance, but mostly in the low-power field. The statistics shows that domestic fibre laser accounts for more than 92% in the low and medium power shipments. However, in high-power applications, foreign companies still play a dominant role. Although the domestic enterprises have made great strides forward in this area through the localization of pumping source package, pump combiner, energy combiner, isolator,

FBG, laser delivery components, and gradually get rid of dependence on foreign enterprises, there are still some huge gaps in respect of technology and quality of key devices. For example, some devices fail to achieve localization production in the full power band such as pump source chip, matched larger-mode-area double-cladding passive fibre and larger-mode-area double-cladding Yb doped fibre. In addition, since most of the fibre laser manufacturers are using imported large double-cladding Yb doped fibre and its supporting double-cladding passive fibre, it indicates that the core raw material of fibre laser has not achieved localization. Meanwhile, the strict verification standards and its long cycle for verification further restrict the development and update of laser fibre

Table 1 Parameters of 125MM Larger-Mode-Area Double Cladding Ytterbium Doped Fibre (LMA DC YDF)

Parameter	10/125	20/125
Core diameter (μm)	10	20
Core NA	0.08±0.05	0.08±0.05
Cladding diameter (μm)	125	125
Cladding shape	Octagon	Octagon
Cladding absorption coefficient (dB/m)	1.6±0.3	3.6±0.4
Slope efficiency	>75%	>70%
Cladding NA	>0.46	>0.46

products. It follows that localization for double-cladding Yb doped fibre and double-cladding passive fibre is an important factor that impedes the smooth development of domestic fibre lasers. Therefore, the localization mission is urgent and without delay.

With five years of technical accumulation, platform creation and product serialization research and development, YOFC has gradually

launched 125μm series larger-mode-area double-cladding Yb doped fibre for low-power fibre laser and 20/400 series double-cladding Yb doped fibre for medium and high-power fibre laser.

Through the MCVD platform, YOFC significantly optimizes photodarkening and high power impact resistance performance of Yb doped fibre for the first time in the country via the process of doping CDS

chelate and aluminum phosphate ytterbium. Meanwhile, thanks to years of technology accumulation, YOFC has established a mature rod process route, which has not only greatly improved the production capacity of single rod, but also improved batch consistency and geometric uniformity of fibre.

125μm larger-mode-area double-cladding Yb doped fibre provides 10/125 and 20/125, as shown in Table 1.

125μm series larger-mode-area double-cladding Yb doped fibre is mainly for the typical MOPA and Q-type 20W fibre laser marking market. With the high absorption coefficient (> 1.6dB/m @ 915nm) and over 60% light-light conversion efficiency, DC-10/125YDF can maintain the 1st amplifier use length of about 4 meters. MOPA marking machine can significantly minimize the use length of fibre and save cost. What's more, the fibre can reduce the design requirements for cooling of laser

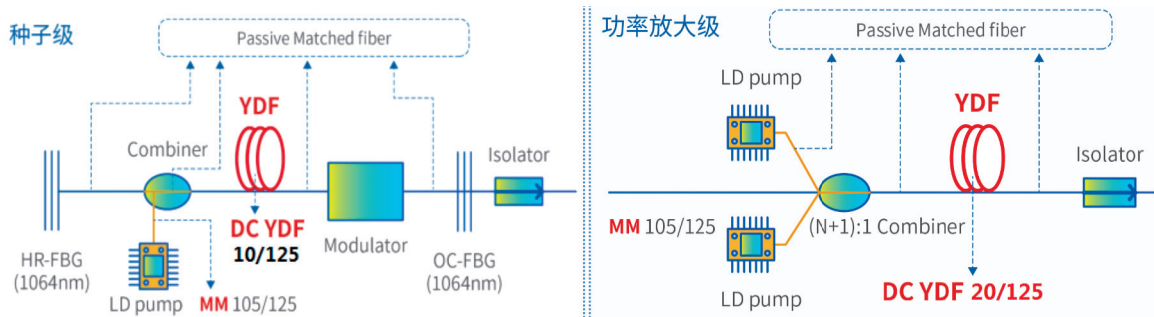


Figure 1 YOFC's low power active and passive fiber solutions

Table 2 Parameters for Larger-Mode-Area Double-Cladding 20/400 Yb Doped Fibre

Parameter	20/400
Core diameter (μm)	20.0±2.0
Core NA	0.065±0.05
Cladding diameter (μm)	400±5
Cladding shape	Octagon
Cladding absorption coefficient (dB/m)	0.39±0.3
Cladding NA	>0.46
Light-to-light conversion efficiency (915nm)	>65%

system in the nearby 915 nm flattened absorption spectrum. Since the Q-switch fibre laser marking machine can reduce the length of resonant cavity, lower cavity loss, compress pulse width, increase the pulse widening tolerance of 2st amplifier, it can guarantee to improve the quality of marking. YOFC's low power active and passive solutions are shown in Figure 1.

The laser applies YOFC's double-cladding 10/125 and 20/125 Yb doped fibre, its power output can be controlled

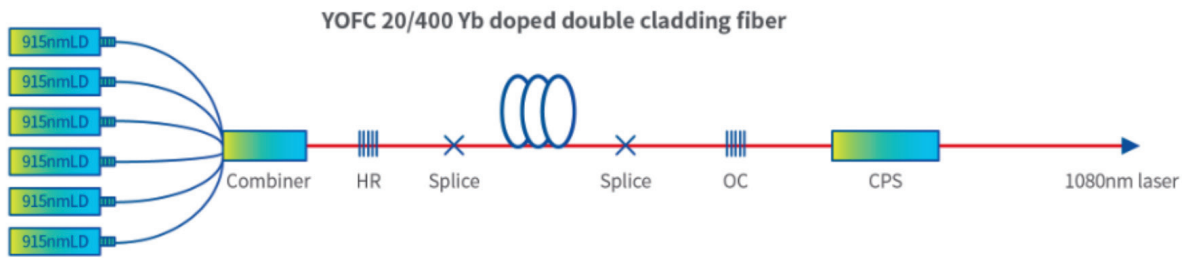


Figure 2 High Power 20/400 Fibre Laser Schematic Diagram

between 19-21 W, and pulse width between 90-110ns. What's more, when YOFC's 20/125 DC-YDF adopts the larger-mode-area design and 20 μ m core doping has optimized its design, the fibre laser can maintain output beam quality of almost M2 <1.5.

With the optimized fibre drawing process, the fibre manufactured by YOFC Company has significantly improved in the environmental stability, especially verified by aging test in the harsh high temperature and humidity environment. When the fibre is applied in an aging environment of 125 $^{\circ}$ C and 2 atmospheric pressures for 24 hours, the glass cladding and the inner coating still maintain consistent stripping force. When laser manufacturer implements 500-hour continuous operating verification process, the power output fluctuation of fibre laser with the fibre manufactured by YOFC is within 5%; when the YOFC 125 μ m series double-doped Yb doped fibre is placed into the 85 $^{\circ}$ C/85% RH aging conditions, the power fluctuations remain within 3%, and the secondary output can still maintain excellent beam quality.

For the key fibre raw materials applied in the CW medium and high-power laser 300W-1500W, YOFC launched a larger-mode-area double-cladding 20/400 Yb doped fibre, the specification are shown in Table 2.

The cost of medium and high power CW laser is mainly from total power and thermal management of the pump source. The active fibre produced by YOFC features high conversion efficiency, which can reduce the power output and heat management difficulty of the pump source. Meanwhile, the higher conversion efficiency can reduce the heat generated by the fibre, greatly retard the aging of the fibre coating, improve the service life of fibre and even the entire machine, thus maintaining the stable power output for much longer time.

20/400 high power fibre laser schematic diagram is shown in Figure 2. The 915nm pump optical coupling is tested with 1080nm high and low reflection grating. In fact, the light-light conversion efficiency of YOFC's larger-mode-area double-cladding 20/400 Yb doped fibre reaches 67%, and will grow gradually with the increase of pump power (See Figure 3

to check test results).

To verify the higher power stability of the YOFC 20/400 fibre, the tester has carried out 1400W stability test. Test results show that power fluctuation value of YOFC 20/400 fibre within 1 hour is at 0.21%, as shown in Figure 4.

Above all, 125 μ m series of 10/125 and 20/125 double-cladding Yb doped fibre for fibre laser in the low power marking application are launched by YOFC. The adhesion between glass cladding and inner coating of fibre in high temperature and humidity environment ensures its operating reliability. What's more, the conversion efficiency for double-cladding 20/400 Yb doped fibre in the medium power has reached 67%, and 1400 w output power fluctuation remains extremely stable.

As we look to the future, YOFC will focus on the future development of fibre laser market, and strive to provide industry-oriented high-quality special fibre based on its deep understanding of fibre laser and its application, production platform, technical expertise and long history of process for special fibre.

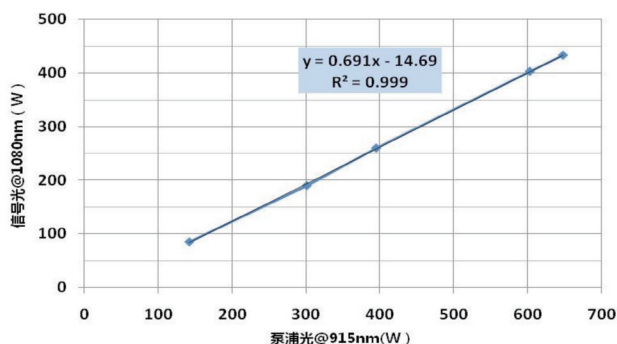


Figure 3 Test Results for 915nm Pump Light-Light Conversion Efficiency

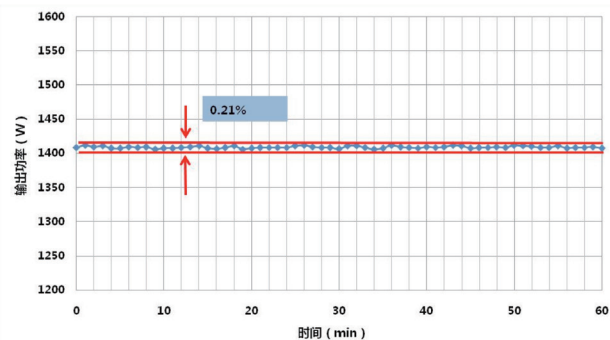


Figure 4 One Continuous Hour Power Test Under 1400W

长飞光系统公司推出 千瓦级高功率光纤光栅

□ 长飞光系统公司 甘泉

2017年4月，长飞光系统公司正式推出了用于千瓦级光纤激光器的双包层光纤光栅（型号：AFBG-DC-20/400-1080），并在6月通过客户的测试认证，成为国内首家能够批量生产用于高功率光纤激光器的光纤光栅厂家，打破了一直以来由国外厂家垄断高功率光纤光栅市场的局面。

光纤激光器已成全球主要 工业激光器之一

作为第三代激光技术的代表，光纤激光器相比传统的半导体激光器、固体激光器和CO₂激光器，具有光束质量好、光电转换效率高、结构紧凑、维护成本低、可靠性高等优点。而这些优点也使得光纤激光器的应用在近十年得到飞速发展，可用于焊接切割、激光打

标、生物医疗、激光雷达、遥感测量、无人驾驶、航空航天等，渗透到生活的每一处。这些应用也进一步推动光纤激光器产业迎来又一个黄金十年。目前，光纤激光器已成为全球主要的工业激光器之一，在全球工业市场的占有率已超过50%。

图1是根据Industrial Laser Solutions在1995~2015年期间每年公布的全球工业激光器销售额数据整理出的增长趋势图。从图中可以看出，除了2009年金融危机时期，工业激光器销售额有所下降外，从1995年起的这20年间，工业激光器一直保持稳定增长，

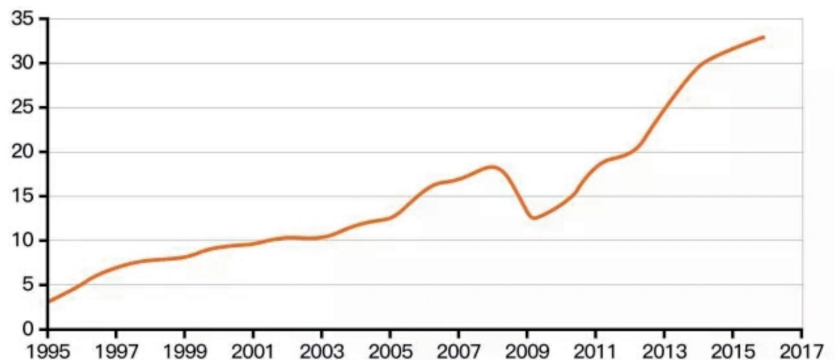


图1 全球工业激光器销售额稳步增长（单位：亿美元）

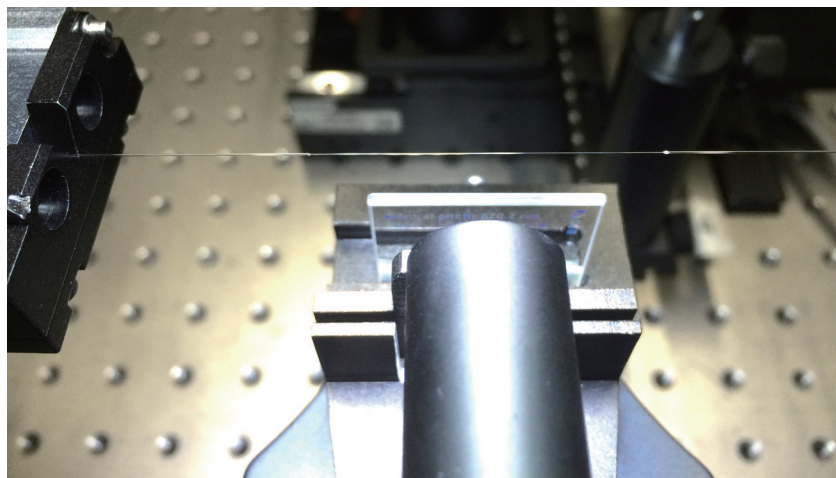


图2 精细的生产工艺

尤其是自2012年之后，涨幅增大。这其中最重要的因素就是光纤激光器市场份额的大幅增长。

打破国外厂家长期垄断

我国是最大的工业激光器市场，占全球市场的24%。近几年，国内光纤激光器厂家持续发力，加快国产化进程，使得中高功率光纤激光器市场已经被大多数国产厂家占据，但是高功率激光器市场仍有超过80%依赖进口。从光纤激光器的组件来看，抽运源封装、抽运源耦合器、激光合束器、特种光纤、激光传输组件已逐步实现国产化，但是一些关键器件，比如高功率光

增长以及成本控制上都受制于国外厂家，丧失了主动性，严重制约了国产高功率光纤激光器的发展。

长飞光系统公司此次推出千瓦级高功率光纤光栅将打破国外厂家长久以来对高功率光纤光栅市场垄断的局面，为国内光纤激光器厂家提供更多、更好的选择。相比其他厂家，长飞光系统公司生产的千瓦级高功率光纤光栅具有以下特点：

- 高反射器和输出耦合器的波长差异控制在0.2nm以内
- 波长、带宽和反射率等参数控制精度高
- 光栅温升系数小
- 高边模抑制比、低损耗

产品指标如表所示。

关于长飞光系统公司

长飞光系统公司第一大股东为长飞公司，主要研发、生产、销售应用于光纤激光器和980nm泵浦激光器的各类高端光纤光栅、光栅滤波器以及光纤色散补偿模块等相关光器件。长飞光系统公司在光器件行业拥有十几年的研发、生产经验，并通过了ISO9001:2008、ISO14001:2004和OHSAS18001:2007认证。



图3 优异的指标参数

纤光栅和高功率光闸几乎全部依赖进口，使得国内厂家无论是在产能

表 长飞光系统公司千瓦级高功率光纤光栅产品指标

型号: AFBG-DC-20/400-1080			
参数	规格		单位
光栅类型	高反射器	输出耦合器	
中心波长C@25° C(测试环境“空气”)	1080±2		nm
波长差异	0.2		nm
峰值反射率@反射带宽(全高半宽)	≥99	15±5	%
带宽(全高半宽)	2.5±0.5nm	1.5±0.5nm	nm
旁瓣抑制比(SLSR)	15		dB
光纤类型	Nufern LMA-GDF-20/400-M 或者客户指定		
最高泵浦光功率	1000		W
光栅光纤长度	左右各1m		

YOFC Optical System Company Launched 1,000W High-Power Fibre Grating

□ Gan Quan from YOFC Optical System Company

In April 2017, YOFC (Wuhan) Optical System Joint Stock Limited Company (hereinafter referred to as "YOFC Optical System Company") launched a double-clad fibre grating (model: AFBG-DC-20/400-1080) officially to be used in 1,000W fibre laser and passed the test and certification of the Client in June. Now the Company has become the first domestic manufacturer that can produce fibre grating for high-power fibre laser in batches and it broke the deadlock that the domestic high-power fibre grating market had been monopolized by foreign manufacturers for years.

Fibre laser has become one of the main industrial lasers in the world

As the representative of G3 laser technology, fibre laser, comparing with traditional semiconductor laser, solid laser and CO2 laser, has merits such as good optical quality, high photoelectric conversion efficiency, compact structure, low maintenance cost and high reliability. By virtue of those merits, fibre laser application has made rapid development in the last decade; it can be used in welding cutting, laser marking, biomedical, laser radar, remote sensing survey, manless driving and aerospace fields and it is in our everyday life. The application

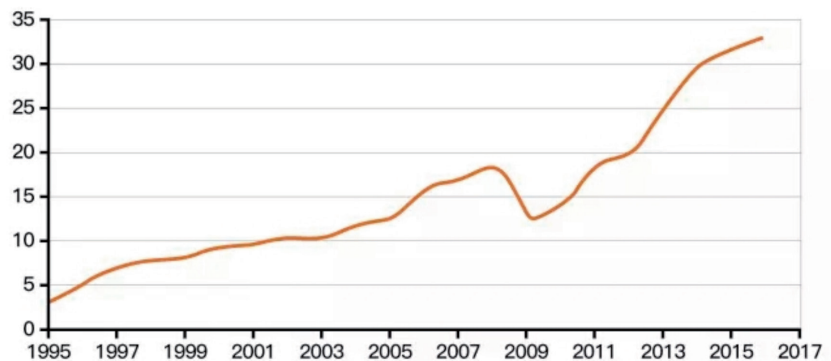


Fig. 1 Global Sales of Industrial Lasers Grew Steadily (Unit: USD 100 million)

will also further promote the fibre laser industry into another "Golden Decade". At present, fibre laser has become one of the main industrial lasers in the world and it occupies more than 50% of the global industrial market.

Fig. 1 shows the growth trend of

global sales of industrial lasers and it is drawn by Industrial Laser Solutions based on the data published each year from 1995 to 2015. To see from this figure, except the period of financial crisis in 2009 during which the sales dropped, the sales of industrial lasers

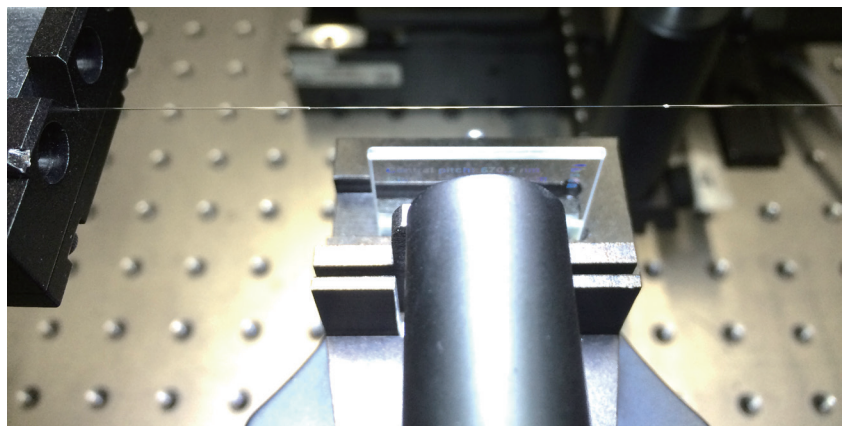


Fig. 2 Fine Production Process

Table Product Indexes of 1,000W High-Power Fibre Grating Launched by YOFC Optical System Company

Model: AFBG-DC-20/400-1080			
Parameter	Specification		Unit
Type of optical grating	High reflector	Output coupler	
Central wavelength@25°C(test environment "air")	1080±2		nm
Wavelength difference	0.2		nm
Peak reflectivity @ reflected bandwidth (full width at half maximum)	≥99	15±5	%
Bandwidth (full width at half maximum)	2.5±0.5nm	1.5±0.5nm	nm
(SLSR) Side lobe suppression ratio (SLSR)	15		dB
Type of optical fibre	Nufern LMA-GDF-20/400-M or customer-specified		
Peak pump power	1000		W
Length of grating fibre	1m at both left and right side		

grew steadily within this 20-year period since 1995, especially since 2012, the growth rate has increased. The most important element is the large increase of market share of fibre laser.

Broke the long-term monopoly of foreign manufacturers

Our country is the largest industrial laser market accounting for 24% of the global market. In recent years, domestic fibre laser manufacturers have been making efforts continuously and accelerated the home-manufacturing process and most of them have occupied the medium and high-power fibre laser market; however, the high-power fibre laser market still depends on import for more than a share of 80%. Seeing from the components of fibre laser, pumping source sealing, pumping source coupler, laser beam combiner, special optical fibre and laser transmission assembly have been domesticated gradually; however, for some key elements including high-power fibre grating and high-power optical shutter, almost all of them depend on import and, for this, domestic manufacturers have been suppressed by foreign manufacturers and tilted away from initiative both in capacity



Fig. 3 Excellent Index Parameters

increase and cost control. As a result, the development of domestic high-power fibre laser has been restricted seriously.

The launching of 1,000W high-power fibre grating of YOFC Optical System Company broke the deadlock that the high-power fibre grating market had been monopolized by foreign manufacturers for years and provided more and better choices for domestic fibre laser manufacturers. Comparing with other manufacturers, YOFC Optical System Company can provide 1,000W high-power fibre grating with the following characteristics:

- Wavelength difference between high reflector and output coupler can be controlled within 0.2nm.

- Parameters including wavelength, bandwidth and reflectivity are high in control precision.

- Temperature rise coefficient of optical grating is low.

- Side-mode suppression ratio is high and loss is low.

Product indexes are shown in the following table.

About YOFC Optical System Company

YOFC (Wuhan) Optical System Joint Stock Limited Company is a joint venture with Yangtze Optical Fibre and Cable Joint Stock Limited Company as the first majority shareholder. This company mainly involves in the R&D, production and sales of various optical devices including high-end fibre grating, grating filter and fibre dispersion compensation module to be used in fibre laser and 980nm pump laser. YOFC Optical System Company has more than ten years of experience in R&D and production of optical device and is an ISO9001:2008, ISO14001:2004 and OHSAS18001:2007 certified company.

CRU世界光纤光缆大会隆重召开

行业领军人物齐聚中国光谷

作为全球光纤及光缆通信行业首屈一指的国际盛会，本届CRU大会邀请了光纤预制棒、光纤及通信电缆产品全球领先制造企业，与产业供应链相关客户及服务商齐聚一堂，共商行业发展、洽谈合作机遇。大会将为与会者提供绝无仅有的与世界各大光纤光缆制造企业决策者沟通的机会，预计将迎来超过700名参会代表。

CRU世界光纤光缆大会是光纤光缆行业全球领先的盛会，当前光纤通讯行业正面临微妙的转折点，因此大会的召开可谓恰逢其时。随着世界迈入信息与通讯科技的重要新时代，此次大会的主要议程将放在光纤网络概念、产品需求及生产能力的重大变动等议题上。为期三天的大会将

使与会人员有机会探索快速发展的全球通信产业对光纤光缆行业带来的影响。同时大会还设立了展览区，用于展示给整个供应链带来重大变革的最新产品、技术及服务。

CRU统计数据显示，中国已经成为全球光纤光缆行业的制造中心、营销中心，未来还将成为研发中心和咨询与服务中心；武汉作为中国最重要的光纤光缆产业基地，素有中国“光谷”的美誉，是了解光纤光缆行业最新发展趋势的不二之选。长飞公司作为中国光纤光缆行业的领军企业，拥有全行业内最长的产业链，掌握了多种光纤光缆生产核心技术，因此成为CRU举办此次盛会的首选合作伙伴。

关于CRU

CRU是矿业、金属、电力、电缆、化肥及化工领域的权威独立咨询机构。CRU集团创立于1960年代，目前聘请超过200名行业专家，在伦敦、北京、圣地亚哥、悉尼以及美国主要城市分别设有办事处。

CRU会展部负责举办矿业、金属以及化肥领域等全球性高端会议/展览。CRU品牌因其权威、独立的行业分析及研究而闻名，其会展服务也以全面细致的研究为基础，为客户提供最可靠的专业意见和最深入的市场分析。

Industrial leaders gathered at OVC for CRU's World Optical Fibre & Cable Conference

As a top-notch international event in the global fibre and cable communication industry, CRU's World Optical Fibre & Cable Conference 2017 invited world leading manufacturers of fibre preform, fibre and communication cable products, to discuss industrial development and explore cooperation opportunities with relevant customers and service providers on the product supply chain. The conference will create a unique opportunity for attendees to communicate with decision makers of major global fibre and cable manufacturers, and is expected to attract more than 700 representatives.

As a world leading fibre and cable event, CRU's World Optical Fibre & Cable Conference has come at the right time when the fibre and communication industry is at a subtle turning point. With the entry of the world into an important new era of information and communication technology, the conference will focus on the concept of fibre network, major changes in product demands and

production capacity, and other issues this year. The three-day conference will enable attendees to explore the impact of the fast-developing global communication industry on the fibre and cable industry. An exhibition zone will be set up during the conference to showcase the latest products, technologies and services causing drastic changes to the supply chain.

According to CRU's statistics, China has become the world fibre and cable manufacturing and marketing center, and will be the R&D, consultation and service center in the future. As the most important fibre and cable industry base in China, Wuhan, known as the "Optics Valley", is the top choice to find out the latest trends of the fibre and cable industry. As a Chinese leading fibre and cable enterprise, YOFC, with the longest industry chain in the industry, has mastered many core production technologies, thus becoming CRU's preferred partner for the conference.

About CRU

CRU is an authoritative independent consulting agency in the fields of mining, metals, electric power, cable, fertilizers and chemicals. Founded in the 1960s, CRU has recruited more than 200 industrial experts, and established offices in London, Beijing, Santiago, Sydney and key U.S. cities.

CRU Convention & Exhibition is responsible for organizing global high-end conventions/exhibitions in fields including mining, metals and fertilizers. CRU is well known for its authoritative and independent industrial analysis and research. Based on comprehensive and detailed research, it provides customers with the most reliable professional opinions and the most in-depth market analysis.

往届CRU光纤光缆大会回顾



2015 CRU亚太光纤光缆大会

2015年10月14-16日，CRU和长飞公司联合主办了2015亚太光纤光缆大会，这是CRU首次将全球性光纤光缆会议安排在亚洲、在中国举办，也是其唯一专注于光纤光缆市场的会议。来自政府部门、电信运营商、设备商、行业组织以及研究机构的嘉宾，与全球顶尖行业专家在内的400余位代表共聚一堂，深入探讨了亚太地区，尤其是中国光纤光缆市场的发展态势。大会主席、长飞公司总裁庄丹在致辞中表示，这次会议将是光纤事业发展史上一次重要的会议，对于促进各国宽带战略的实施，推动光通信产业链的合作共赢，实现光纤光缆行业的蓬勃发展，具有极其重要的意义。

在大会开幕式上，武汉市委常委、常务副市长贾耀斌致欢迎词并宣布大会开幕。贾副市长表示，光电子信息产业是光谷代表国家参与全球竞争的主力，

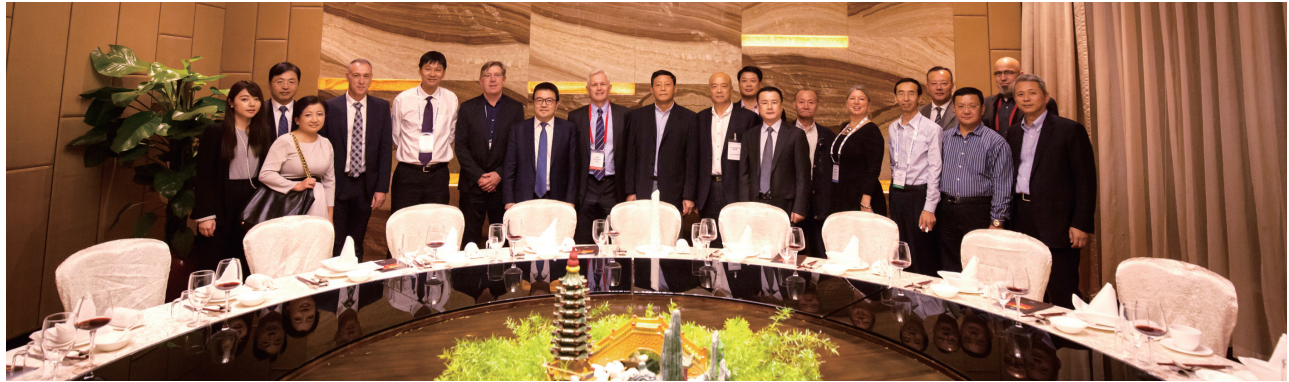
在这里诞生了中国第一根光纤，建成了中国最大的光纤光缆研发生产基地，光纤光缆产销规模全球第一，长飞光纤光缆股份有限公司、烽火科技集团等光纤光缆企业全球知名。贾副市长认为，CRU亚太光纤光缆大会来到武汉正当其时，大会是全球光纤光缆行业的盛会，也将成为促进武汉光纤光缆产业发展的盛会，成为全球光纤光缆产业相关同仁欢聚的盛会，必将为光纤光缆业的发展谱写浓墨重彩的篇章。

会上，中国通信产业的权威主导媒体——人民邮电社总编辑武锁宁主持尖峰对话环节，中国五大光纤光缆企业领军人物——长飞公司总裁庄丹、烽火公司总裁何书平、亨通公司董事长钱建林、富通集团法定董事总裁肖玮、中天科技集团总裁薛驰展开思想碰撞，共同探讨中国光纤光缆市场的发展现状和前

景。庄丹表示，信息化建设、“一带一路”倡议、“宽带中国”战略、“中国制造2025”都将为行业发展注入持续动力。中国光纤光缆企业面对时代赋予的新机遇，需加快转型升级步伐，提升技术创新能力，加快“走出去”的步伐，在国际市场上扮演更为重要的角色。

长飞公司总裁庄丹在会议期间接受了媒体采访，在采访中庄总表示，随着目前运营商加快建设超宽带，100G和超100G的不断部署，在光纤技术研发领域，（超）低损耗、大有效面积光纤已经成为目前业界研发的重点。长飞公司在超低衰减大有效面积光纤方面的研发走在行业前列，尤其是在决定光纤性能的预制棒制造技术上，长飞已经掌握了VAD和OVD工艺，是全球唯一一家同时拥有三种预制棒技术的公司。

Review of CRU's Optical Fibre & Cable Conference



2015 CRU's APAC Optical Fibre & Cable Conference

CRU co-hosted APAC Optical Fibre & Cable Conference 2015 with YOFC from October 14 to 16, 2015. This was the first time that CRU had hosted the global fibre and cable conference in Asia and China. It is also CRU's only conference focusing on the fibre and cable market. Guests from government departments, telecommunication operators, equipment manufacturers, industrial organizations and research institutes got together with more than 400 representatives including world top industrial experts, to look into the trends of the fibre and cable market in the Asia-Pacific region, especially China. Zhuang Dan, Chairman of the Conference and President of YOFC delivered an address. As an important conference in the history of the fiber industry, the conference is of great significance to promoting the implementation of global broadband strategies, pushing forward win-win cooperation in the optical communication industry and achieving the prosperity of the fibre & cable industry, said him.

At the opening ceremony, Jia Yaobin, Member of the Standing Committee of the CPC Wuhan Municipal Committee and Executive Vice Mayor of Wuhan delivered a welcome address and announced the opening of the conference. The optoelectronic information industry is the main force with which the Optics Valley of China (OVC) participates in global competition on behalf of China. Here China's first fibre emerged and China's largest fibre and cable R&D and production base was established here. OVC leads the world in fibre and cable output and sales. Fibre and cable enterprises like YOFC and FiberHome are renowned in the world. CRU's APAC Optical Fibre & Cable Conference has come to Wuhan at the right time. As a global fibre and cable event,

the conference will bring together industrial peers from across the world, promote the development of Wuhan's fibre and cable industry, and open a brilliant page for the development of the fibre and cable industry, said him.

At the conference, Wu Suoning, Editor-in-Chief of People's Posts and Telecommunications News, an authoritative media outlet in China's communication industry, presided over the summit dialogue. The leaders of China's five major fibre and cable enterprises—Zhuang Dan, President of YOFC; He Shuping, President of FiberHome; Qian Jianlin, Chairman of Hengtong Group; Xiao Wei, President of Futong Group and Xue Chi, President of ZTT Group exchanged ideas on the actualities and prospect of the Chinese fibre and cable market. Informatization construction, the "Belt and Road" Initiative, the "Broadband China" strategy and "Made in China 2025" will inject sustained power into the industry. Facing the new opportunity from the times, Chinese fibre and cable enterprises need to speed up transformation and upgrading, improve innovation capacity, quicken the pace to go global and play an important role in the international market.

Zhuang granted an interview on the sidelines of the conference. With the acceleration in UWB construction and the constant deployment of 100G and 100G+ band, fibers with (ultra) low loss and large effective area have become the R&D focus of the industry. YOFC has kept ahead in the industry in the R&D of fibres with ultra low attenuation and large effective area. Particularly, YOFC has mastered VAD and OVD processes for manufacturing performs decisive to fibre performance, to become the world's only company owning three preform technologies.

2016 CRU世界光纤光缆大会



继2015年亚太光纤光缆大会成功举办后，2016年11月2-4日，由CRU（英国商品研究所）和长飞公司联合主办的首届全球性光纤光缆会议——世界光纤光缆大会“落地”中国光谷。会议吸引了来自政府部门、电信运营商、设备商、行业组织以及研究机构的嘉宾与全球顶尖行业专家在内的600余位代表，聚集了长飞、烽火、富通、亨通、中天等为代表的中国行业顶尖企业与康宁、普睿司曼、信越、斯特雷德等为代表的美国、日本、欧洲、印度光纤光缆产业巨头。同时，大会还引起了投资机构的高度关注，包括中金、中信证券、弘毅投资等金融机构的代表出席了会议。

2016世界光纤光缆大会主席、长飞公司总裁庄丹表示，近年来全球光纤光缆行业方兴未艾，“中国速度”更是引人注目。2016年全球约60%光缆产量来自于中国，长飞公司更是成长为全球第一大光纤预制棒及光纤供应商和全球第二大光缆供应商。得益于市场需求的持续增长以及技术创新能力的不断提升，中国成为全球光纤光缆行业的“四大中心”——研发中心、制造中心、销售中心、咨询与服务中心指日可待。CRU在中国召开全球行业年度盛会，提供了一个中国光纤光缆厂商与全球业内人士对话的平台，对我国建设“四大中心”将起到积极推动作用。通过CRU大会，大量的国际市场客户、上下游厂商进一步了解关于中国光纤光缆市场的信息，将有利于中国光纤光缆厂商开拓国际市场，迎来新的发展机遇；中国厂商聆听业内专家对行业发展趋势的预测和未来技术发展方向讨论，

获取行业内的前沿信息，也将为中国光纤光缆产业的繁荣发展注入新的活力，这将是整个行业共同的愿望。

在本次大会亮点的“尖峰对话”环节，中国光纤光缆企业五大领军人物——长飞光纤光缆股份有限公司总裁庄丹、烽火通信科技股份有限公司总裁戈俊、富通集团总裁肖玮、亨通集团执行总裁钱建林、中天科技集团总裁薛驰展开了思想碰撞，共同探讨中国光纤光缆市场的发展现状和前景。庄丹表示，“凡益之道，与时偕行”，随着社会各界对信息消费的需求迅猛增长，以及通信技术的快速发展，4G、5G、FTTx等通信网络持续规模建设，全球将在更广领域内逐步构建泛在的信息传输网络，光纤光缆的市场需求将持续旺盛。广阔的市场需要创新的精神去开拓，更需要合作共赢，本次会议的召开将会加大行业间交流互动，实现优势互补，共同为未来发展献言献策，推进全球光纤光缆行业的健康发展。

首届世界光纤光缆大会在中国武汉光谷举办，充分体现了中国光纤光缆产业国际话语权和影响力的提升。经过数十年的发展，中国光纤光缆产业规模不断增长，产业创新能力也获得了大幅提升，与发达国家的差距日渐缩小，甚至在某些领域实现了赶超。尤为值得一提的是，在“一带一路”战略的指引下，中国光纤光缆企业正在加大“走出去”的力度。长飞的国际化布局已经显现成效，在缅甸、印尼和南非设立了海外工厂，未来几年，长飞每年将在海外增设一个光纤或者光缆厂。

2016 CRU's World Optical Fibre & Cable Conference

After the success of CRU's APAC Optical Fibre & Cable Conference 2015, the 1st World Optical Fibre & Cable Conference, hosted by the Commodity Research Unit (CRU) and Yangtze Fibre and Cable Joint Stock Limited Company (YOFC), was held at the Optics Valley of China (OVC) from November 2 to 4, 2016. The conference attracted more than 600 guests and world top industrial experts from government departments, telecommunication operators, equipment manufacturers, industrial organizations and research institutes, bringing together Chinese top fibre and cable enterprises represented by YOFC, FiberHome, Futong, Hengtong and ZTT, as well as American, Japanese, European and Indian fibre and cable giants represented by Corning, Prysmian, ShinEtsu and Sterlite. The conference also drew great attention from institutional investors, including CICC, CITIC Securities, Hony Capital and other financial institutions which sent representatives for the conference.

In recent years, the global fibre and cable industry has been rising and "China Speed" has been more compelling, said Zhuang Dan, Chairman of CRU's World Optical Fibre & Cable Conference 2016 and President of YOFC. In 2016, China contributed about 60 percent of global cable output, and YOFC developed into the world's largest fibre preform and fibre supplier, as well as the world's second-largest cable supplier. With the continuous growth of market demand and the constant improvement in innovation capacity, China is expected to become the "four centers" (R&D center, manufacturing center, sales center, consulting and service center) in the global fibre and cable industry. The annual global industrial event hosted by CRU in China has created an exchange platform for Chinese fibre and cable manufacturers and global industry insiders, and boosted the building of China into the "four centers". Through the conference, multitudes of international customers and upstream and downstream manufacturers have acquired further knowledge of the Chinese fibre and cable market, which will provide a new opportunity for Chinese fibre and cable manufacturers to develop the international market; Chinese manufacturers have acquired frontier industrial information by listening to industrial experts' predictions of industrial trends and discussions about future industrial development, which will inject new vitality for the prosperity of China's fibre and cable industry—the common wish of the industry.



In the "summit dialogue" highlighting the conference, the leaders of China's five major fibre and cable enterprises—Zhuang Dan, President of YOFC; He Shuping, President of FiberHome; Qian Jianlin, Chairman of Hengtong Group; Xiao Wei, President of Futong Group and Xue Chi, President of ZTT Group exchanged ideas on the actualities and prospect of the Chinese fibre and cable market. As the Chinese saying goes, "All good principles should adapt to changing times to remain relevant", with the surge in the social demand for information consumption and the rapid development of communication technologies, 4G, 5G, FTTx and other communication networks have been constructed continuously on a large scale, the global ubiquitous information network will be built progressively in more fields, and the market demand for fibres and cables will stay robust. A broad market needs innovative development and win-win cooperation. The conference will strengthen industrial exchange and interaction, accomplish advantage complementation, offer advice on future development and promote the sound development of the global fibre and cable industry, said Zhuang.

The hosting of the 1st World Optical Fibre & Cable Conference at OVC, Wuhan, China shows that China's fibre and cable industry has enhanced its international voice and influence. Over the past decades, China's fibre and cable industry has grown constantly and improved in innovation capacity significantly, thus gradually narrowing its gap with developed countries and overtaking them in some fields. Remarkably, guided by the "Belt and Road" strategy, Chinese fibre and cable enterprises are stepping up globalization. YOFC's globalization layout has taken effect. YOFC has established plants in Myanmar, Indonesia and South Africa, and will establish a new one abroad annually over the next few years.

2017世界光纤光缆大会 精彩活动集锦



为期3天的2017世界光纤光缆大会即将拉开序幕，大会期间有什么样的活动安排？行业专家将聚焦哪些热点话题？未来光纤光缆技术创新的方向在哪里？下面，让小编为大家揭秘本次大会的精彩专题活动。



专题 1

中国光纤光缆行业高层对话

世界领先光纤光缆生产商共话未来全球光纤光缆供应所面临的挑战及机遇

- ◎ 新增预制棒产能情况？短中期内供应量是否满足行业需求？
- ◎ 当前境内及出口重点。中方生产商未来将在出口市场扮演何种角色？
- ◎ 为迎接超级宽带和5G网络到来制定了哪些长期战略？
- ◎ 有关产品创新设计和创新制造方面的重点？
- ◎ 行业先驱预计市场将出现哪些新光纤应用进而引领新设计

发言人包括：

庄丹 长飞光纤光缆股份有限公司 执行董事兼总裁
肖玮 富通集团有限公司 执行董事兼总裁
戈俊 烽火通信科技股份有限公司 总裁
钱建林 亨通集团有限公司 执行总裁
薛驰 中天科技集团有限公司 总裁
(按发言顺序排列)



专题 2

中国主要消费商对光缆需求的见解

聆听电信运营商、公共设施及广播公司预测下一代光纤光缆需求。

- ◎ 网络运营商们对“宽带中国”战略以及其他光纤相关网络建设工作的推进情况？
- ◎ 高清网络和按需消费的趋势将如何拉动未来网络的带宽需求？
- ◎ 光纤光缆供应链将如何为电信运营商、公共设施及广播公司提升服务？
- ◎ 电信行业价值链如何演变？电信运营商、网络服务供应商以及数据中心的关系？

聆听中国电信、中国移动、中国联通以及广电高层发言人的专题演讲并参与专题讨论。

专题 3 电信网络的未来

迎接5G时代的到来

- ◎ 5G时代的传输网络要求?
- ◎ 部署的时间进度?
- ◎ 对基站部署、前向回传、回程网络的影响?
- ◎ 如何将宽带和5G部署战略进行整合?

数据中心发展趋势

- ◎ 当前数据中心扩张趋势以及数据中心设计变化
- ◎ 云计算、大数据、物联网以及智慧城市计划的发展
- ◎ 数据中心互联的光纤需求
- ◎ 数据中心基础设施和光学收发机的技术发展

未来网络架构分析

- ◎ 了解网络架构的演变以及其对光纤光缆需求的影响
- ◎ 网络架构、设备以及网络模式的未来发展?

探索OTT带宽驱动因素

- ◎ 未来哪些OTT服务将拉动消费者带宽需求?
 - ◎ 网络应为下一代OTT服务作何准备?
- 电信网络公司的思维领袖及改革者专题演讲。

专题 4 全球预制棒市场展望

- ◎ 中国以外的新增及扩产项目将如何影响预制棒市场?
 - ◎ 短期到长期市场基本面将如何变化?
 - ◎ 预计瓶颈将在何时何地发生以及行业应如何准备?
- CRU以及主要预制棒生产商专题演讲。

专题 5 全球光纤光缆供需情况

- ◎ 光纤网络部署的区域发展
 - ◎ 不同区域拉动需求的因素有哪些以及预计发展速度如何?
 - ◎ 资本市场如何看待这一情况? 进一步兼并和收购是否能够让行业获益?
- CRU、全球各大市场国际电信及预制棒生产商关于全球市场及区域市场专题分析。

专题 6 全球光纤入户部署小组

全球光纤入户趋势概述 - 哪些市场已饱和, 何处仍具备商机?

- ◎ 部署过程中面临哪些挑战以及解决方案?
- ◎ 全球关于光纤部署工作有哪些法规及政策趋势?

- ◎ 如何能够有效地向消费者传达光纤入户带来的益处?
 - ◎ 为确保网络质量和服务质量采取了哪些新的技术?
- 国际光纤入户理事会及光纤部署专家专题讨论会。

专题 7 新的光纤种类及涂层

- ◎ 光纤发展最新趋势?
- ◎ 光纤及光缆技术的革新将如何影响市场?
- ◎ 生产商们为应对网络发展和高性能应用将如何提升光缆质量?

◎ 为实现价值最大化光纤光缆生产商应将研发重点放在何处?

光缆生产、设计和涂层等技术先驱和改革者进行专题演讲。

专题 8 光纤光缆优化生产

- ◎ 生产者如何建设智能现代化光缆工厂?
 - ◎ 光纤生产流程中的核心经济因素如何转变?
 - ◎ 如何通过合理使用最新生产工艺提高利润?
- 光纤光缆生产方面的领先技术及服务供应商专题演讲。

Highlights of World Optical Fibre & Cable Conference 2017



The three-day World Optical Fibre and Cable Conference 2017 is around the corner. What is the schedule? What will industrial talk about? What is the future of optical fibre and cable innovation? Now let me show you the highlights.

Session 1

The China optical fibre and cable industry leadership panel

The world's leading producers of optical fibre and cable discuss the challenges and opportunities ahead for supplying global fibre and cable markets.

- ◎ What is the update on new preform capacity? Is the industry keeping pace with demand in the short- to medium-term?
- ◎ Current domestic vs. export focus. What is the potential future role for Chinese producers in export markets?
- ◎ What is the longer-term strategy in preparation for the arrival of ultra-broadband and 5G networks?
- ◎ What emphasis is being placed on innovation in product design and manufacturing?
- ◎ New fibre applications that industry leaders expect to disrupt the market and drive the next wave of design

Featuring presentations from

Dan Zhuang The Executive Director and President of Yangtze Optical Fibre and Cable Joint Stock Limited Company
 Wei Xiao The Executive director and President of Futong Group Co.,Ltd.
 Jun Ge The President of FiberHome Telecommunication Technologies Co.,Ltd
 Jianlin Qian The Executive President of Hengtong Group Co.,Ltd.
 Chi Xue Zhongtian Technology Group Co.,Ltd.
 (Arrange in the order of speech)

Session 2

Demand insights from China's major consumers

Hear telecom operators, utilities and broadcasters outline what they forecast will be their next generation of optical fibre and cable needs.

- ◎ How is the "Broadband China" strategy and the promotion of all-optical network construction being implemented by network operators?
- ◎ What trends in high definition and on-demand consumer trends will be driving increased bandwidth requirements on future networks?
- ◎ How can the optical fibre and cable supply chain improve their service offering for telecom operators, utilities and broadcasters?
- ◎ Is the value chain in telecoms evolving? What are the relationships between operators, ISPs and data centres?

Featuring presentations and panel discussion with high-level speakers from China Telecom, China Mobile, China Unicom and CTV.

Session 3

The future of telecoms networks

Preparing for the 5G era

- ◎ What are the transport network requirements in the 5G era?

- ◎ What is the timeline for deployment?
- ◎ What will be the impact on base station deployment, front haul and back haul networks
- ◎ How can broadband and 5G deployment strategies become integrated?

Data centre trends

- Current trend of data centre expansion and evolution of data centre design
- Cloud, Big Data, IOT and Smart City developments
- Fibre requirements for data centre interconnect (DCI)
- Data centre infrastructure and optical transceiver technology advancement

Future network architecture insights

- Understanding the evolution of network architecture and what that means for fibre and cable demand
- What is the outlook for network architecture, equipment and networking modes?

Exploring OTT bandwidth drivers

- What OTT services will be driving bandwidth demand from consumers in the future?

- How can networks prepare for the generation of OTT services?

Session 4

Global preform market outlook

- What new projects or expansions outside of China will impact the preform market?
- How are the market fundamentals shifting from the short to the long-term?
- Where and when will bottlenecks appear and how can the industry prepare?

Featuring presentations from CRU and major preform manufacturing companies.

Session 5

Global fibre and cable supply and demand

- Regional development of fibre network deployment
- What is driving demand in the different regions and

what growth rate is to be expected?

- What is the view from capital markets? Could the industry benefit from further M&A activity?

Featuring a global overview and regional spotlights from CRU and international telecom and major preform production companies in the most exciting international markets.

Session 6

Global FTTx Deployment Panel

- Overview of international FTTx trends - where is deployment saturated and where are there still opportunities?
- What challenges of deployment have been encountered and what solutions have been found?
- What are the regulation and policy trends relating to fibre deployment around the world?
- How can the message of the benefits of FTTx be communicated most effectively to consumers?
- How have new technologies and techniques have been used to ensure network quality and quality of service?

Featuring panel discussion with international FTTH Councils and fibre deployment experts.

Session 7

New fibre types and coatings

- What are the latest trends in the development of optical fibre?
- What advances in optical fibre and cable technology will disrupt the market?
- How can manufacturers enhance the quality of cable for advanced networks and other high-performance applications?
- Where should optical fibre and cable manufacturers focus R&D in order to add maximum value?

Featuring presentations from technical leaders and innovators in cable manufacturing, design and coating.

Session 8

Optical fibre and cable production optimisation

- How can manufacturers create a smart and modern cable factory?

- How are the core economics of the optical fibre manufacturing process evolving?

How can proper application of the latest production processes improve margins?

Featuring presentations from leading suppliers of technology and services to manufacturers of optical fibre and cable.



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