Stack-and-draw revisited for the engineering of multimaterial ribbon fibers with large surface-area

Sylvain Danto, ICMCB, University of Bordeaux

Multi-functionality in glasses managed at the micrometer scale by an imprinting thermo-electrical process

Marc Dussauze, ISM, University of Bordeaux, CNRS

Specialty fibers for sensing

Thierry Robin, IXBlue company (https://www.ixblue.com)

High refractive index glasses designed for Augmented Reality (AR) and Mixed Reality (MR)

Antoine Lepicard, Corning company (https://www.corning.com)

Sylvain Danto, "Stack-and-draw revisited for the engineering of multimaterial ribbon fibers with large surface-area", ICMCB, University of Bordeaux

ABSTRACT

Nowadays new technological devices request for a higher level of integration within ever shrinking devices. In that respect fiber drawing technology offers many assets. It is slowly morphing into a processing route for producing complex, scalable multimaterial photonics or electronics devices. The method naturally generates high aspect-ratio flexible devices of arbitrary length, the large surface-area offering an ideal platform for subsequent functionalization. Lastly, fiber drawing is a relatively straightforward low-cost technology (as compared to in semiconductor industry), requiring small surface footprint and no onerous clean-room facilities. In this framework here we will present recent progresses in the fabrication of multimaterial fibers using glasses with intermediate T_g, including boro-phosphate glasses (Tg ~350-400°C) and soda-lime glasses (Tg ~580-620°C). More specifically, we demonstrate that the stack-and-draw technique can be expanded to unusual materials (glasses, metals) association and fiber profile geometries (Figure 1). This approach relies on the stacking of flat oxide glass slides into a preform, which is then thermally elongated into tens-of-meters-long ribbon fibers with preserved cross-section ratio. Main properties and fabrication feature of the method are introduced. We believe the insertion of intermediate-Tg oxide glasses within flat multimaterial fibers will give access to a whole new range of functionalities, in electro-optics or sensing. In order to illustrate the versatility of the method, a panel of fibers with diverse applications is exposed, including click chemistry for bio-chemical sensing and experimental development of compact, all-solid fiber optical detector applied to gas analysis by means of fiber-tip plasma spectroscopy.

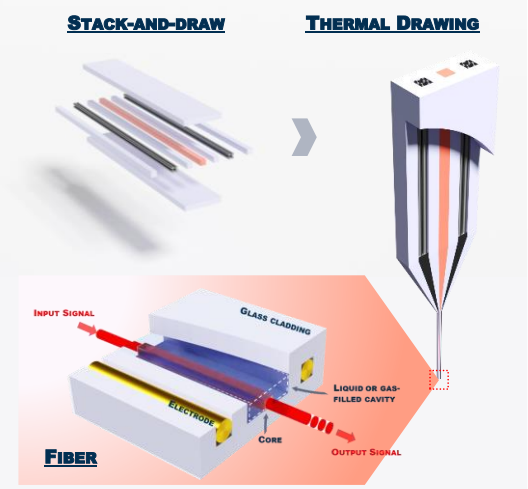

Fig. *Multimaterial ribbon fibers elaborated by the stack-and-draw method*

References

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FUNGLASS DAYS – “Glass surface and multimaterials fibers”

BIO

Sylvain DANTO *received his Ph.D. degree in Materials Science from the University of Rennes (Rennes, France) in 2005 where he worked on amorphous semiconductors for data storage and infrared optics. Next he joined the group of the Prof. Yoel Fink at the Massachusetts Institute of Technology as a research associate (2006-2010). At MIT he developed novel multi-material optical fibers for optoelectronic devices. Then he joined the group of the Prof. Kathleen Richardson at Clemson University, USA, as a research scientist (2011-2013). There he pursued research on amorphous semiconductors for mid-infrared optics and photonics, in bulk, film and fiber forms. Currently he is located at the Institut de Chimie de la Matière Condensée de Bordeaux (ICMCB, UMR 5026 CNRS University of Bordeaux). There he aims at establishing a new research activity and dedicated facility on soft-Tg-glass-based specialty optical fibers for applications ranging mid-infrared optics, photosensitive fibers, fiber Lasers and novel smart fibers with unique functionalities. Dr. S. Danto is coauthor of more than 50 journal publications, 2 book-chapters and he holds 4 patents on optical glasses and fibers.*

FUNGLASS DAYS – "Glass surface and multimaterials fibers"

Marc Dussauze, "Multi-functionality in glasses managed at the micrometer scale by an imprinting thermo-electrical process", ISM, CNRS, University of Bordeaux

ABSTRACT

Photonics is a key technology sector with a very high potential. This type of technology touches and will touch more and more economic fields such as telecommunications, security, military, quantum computers, autonomous vehicles and health. Research and development efforts in this area are currently focused on integrating a large number and variety of optical and electrical functionalities on the same system, following the same trajectory as that known for the micro/nano electronics field. In parallel, the addition of chemical or biological functionality to a photonic system promises the emergence of a new field of analysis offering unique features for improving the performance of current detection techniques. In order to support this strong growth, there is a significant need for research and innovation in the development of new multifunctional materials that can meet all these expectations

In this context, we will focus our attention on recent advancements demonstrating how glass chemistry combined to thermo-electrical processes allow designing multifunctional glasses. Such approach developed as an imprinting method can format surface microstructure for a large variety of properties such as surface reactivity, surface electrical potential, gradient of refractive index and second order optical properties.

BIO

Marc Dussauze *43, Chargé de recherche CNRS, Université de Bordeaux, France. He is currently a CNRS researcher at the Institute of Molecular Science (ISM) from the University of Bordeaux. He is specialist in glass chemistry, nonlinear optics as well as in structural characterizations by vibrational spectroscopy. His investigations are mainly related to the development of optical or electrical polarization processes to manage chemical and optical (linear and nonlinear) properties of glassy materials. He received a PhD in physical-chemistry of condensed matter from the University of Bordeaux in 2005. Prior to enter the CNRS in 2009, Marc Dussauze was a postdoctoral fellow at the National Hellenic Research Foundation of Athens, Greece. He received the CNRS bronze medal in 2016.*

FUNGLASS DAYS – “Glass surface and multimaterials fibers”

Thierry Robin, “Specialty fibers for sensing”, IXBlue company

ABSTRACT

iXblue. To draw where no man as drawn before...

Specialty optical fibers have found their way in many fields, some well-known such as telecommunication, fiber lasers, or Gyroscopes, but also in more surprising applications such as measuring radiation levels onboard the International Space Station.

In this presentation we will define what is a ’specialty’ optical fiber and we will explain some of the challenges we face at iXblue when it comes to design these fibers and more specifically what it implies in terms of glass composition.

Antoine Lepicard, “High refractive index glasses designed for Augmented Reality (AR) and Mixed Reality (MR)”, Corning company

ABSTRACT

Corning is a world’s leading innovator in materials science. For nearly 170 years, Corning has combined its unparalleled expertise in glass science, ceramics science, and optical physics to develop products having a significant impact on people’s lives. Our track record of innovation includes the first glass bulbs for Thomas Edison’s electric light, the first low-loss optical fiber and the first damage-resistant cover glass for mobile devices. Today we continue to innovate to serve new and exciting innovations while caring about sustainability, striving every day to make a positive difference in the world by supporting our people and communities, preserving our environment, and engaging in responsible business and manufacturing processes.

In this talk, we will discuss our efforts to develop high refractive index glasses designed for Augmented Reality (AR) and Mixed Reality (MR). Among the diverse optical solutions considered, optical waveguides are thought to have the potential to become the prevailing technology as they combine good user performances and mass production capabilities. For continuously innovating AR/MR solutions, there is a strong need to offer wider field-of-view, thinner, lighter, and brighter devices. High refractive index glasses directly correlate with wider field-of-view but come with several challenges, namely higher density, and smaller bandgap. We will discuss how a glass research team consisting of glass scientists, experts in glass characterization and processing can develop an optimized composition with the best tradeoffs between refractive index, density, and transmittance.

BIO

Antoine Lepicard *is a Senior Research Scientist at the Corning European Technology Center in Fontainebleau, France. He received a MSc from Ecole Nationale Supérieure de Céramique Industrielle in Limoges, and a PhD in Materials Science from the University of Central Florida, Orlando, FL and the University of Bordeaux working on thermal poling of optical glasses. He joined Corning in 2018 where he is conducting research and development work on novel specialty glass products to meet the challenging set of requirements governed by future applications.*