Laser-based drawing of optical fibre

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Abstract: This work explores using CO-laser heating to fabricate speciality optical fibre from unconventional materials. The unique temperature dynamics of this furnace demonstrated fine control of crystallisation in crystal-core glass-clad fibres.

The fabrication of optical fibre is an extensive field pushing both the highly optimized processes of telecom fibre production and novel approaches of specialty fibre fabrication. Some types of speciality optical fibres, such as hybrid material fibres, require specialised fabrication techniques with more finesse than conventional induction furnaces. In certain materials, the large thermal exposure supplied by induction furnaces leads to unwanted effects such as contaminant diffusion, dissociation, or unwanted crystalline structures. To address these kinds of specialty fibres, the technique of localised laser heating can be used. Laser heating provides a highly localized hotspot, providing enough energy to soften the preform and draw fibre while minimizing overall thermal exposure. This provides a highly controllable hot zone with a rapid temperature response.

Additionally, the type of laser used for heating the preform plays an important role. Currently, the carbon dioxide (CO_2) laser is the common option for glass processing. This is due to its 10.6 μm output radiation being highly absorbed in silica, readily depositing large amounts of energy at the surface of the material. This is valuable for cutting or ablating the material surface but not desirable for evenly heating large volumes of material. To address this, we use a commercially available carbon monoxide (CO) laser, which operates at 5.5 μm. This wavelength has a larger penetration depth in silica resulting in energy being deposited further into the material. Thus, achieving a more homogeneous transverse temperature distribution as well as a higher average temperature with minimal surface vaporization.

This talk covers the results from a recently constructed CO laser-based draw tower for the fabrication of hybrid material fibres.

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Biography: Clarissa is currently a researcher at the Royal Institute of Technology (KTH) in Stockholm and specialises in optical fibre fabrication. She obtained her PhD from the University of Bath in 2017 after developing hollow-core fibre for use in mode-locked lasers. After a two-year post-doc in the Max Planck Institute in Germany, she joined the KTH Laser Physics group in 2019 to construct and run the fibre fabrication facilities at KTH.