Visualization of glass flow during extrusion to track glass deformations

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Billet extrusion is one of the fabrication techniques used to produce soft glass and polymer microstructured preforms and optical fibers (MOFs) [1–3]. Extrusion can be advantageous for structures that would be difficult to fabricate with standard stacking methods, such as those with varied hole sizes with non-uniform spacing [4-7]. One recent example will be discussed, a novel polarization-maintaining photonic crystal fiber (PM-PCF) made of chalcogenide glass designed for Mid-Infrared lasers. However initial work has shown that deformations associated with the die swell and tapering of the glass preform under its own weight when extruding the preform leads to a non-ideal structure, requiring multiple design iterations to converge on the target design. Thus, it is desirable to be able to predict preform deformations, by developing a model that would enable incorporation of multiple physical effects that occur during the extrusion process.

The paper reports an experimental method to visualize glass flow through an extrusion die. A soda-lime glass was used as the model glass for the visualization. The initial work used simple die designs to refine existing theoretical models. The results of this work would help to understand the interaction between glass and the die structure during the extrusion process, and the role of a die swell on the preform deformations. The expected outcome of this work is to develop a design toolkit, which would allow to predict the deformations during extrusion and use it as a guiding tool in a die design in the future.

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