Department of Aerospace and Mechanical Engineering

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Additive Manufacturing of Glass

Tuesday,

November 28th, 2017, 3:30P.M.

Geddes Hall

Refreshments served 365C Fitzpatrick Hall at 3:00 p.m.

Additive manufacturing, or 3D printing, has been used for printing plastics, metals, and some ceramics. However, little work has been performed on printing glass. Glass has unique properties including transparency, low temperature sensitivity, high electrical resistivity, and sufficient hardness for polishing which make it an important material for scientific and engineering with widespread applications in optics, communication and electronics. Additive manufacturing provides the potential to create parts with complicated geometries and low production volumes as well as opening up new possibilities for creating optics with graded optical properties. However, the high viscosity of most glasses makes powder consolidation difficult because of bubble entrapment. This presentation describes ongoing work on depositing optically transparent glass components using a new laser-heated, filament-fed process. In this process, a CO_2 laser is used to locally melt, continuously fed, small-diameter glass rods and fiber. 3D shapes are constructed by moving a CNC stage relative to the intersection of the filament and the laser beam. Material consolidated by the melting process, solidifies out of the melt pool as the part translates relative to the laser beam allowing the deposition of free-standing structures. The 10.6 μm laser energy is well absorbed by the glass and the build platform is heated to minimize thermal stresses during deposition. Starting with fulling dense feed-stock and smoothly melting it allows deposition of glass with transparency approaching furnace cast pieces. The presentation discusses printing soda-lime, GE214, and borosilicate glasses. Preliminary work on depositing/testing cylindrical lenses is also presented along with printing single mode optical fiber. Because the additive manufacturing process allows the material composition of the work piece to be adjusted on a 3D volumetric basis it will be useful for making gradient index optics. In addition, the AM approach is useful for printing integrated photonics and depositing hermetic seals.

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If you are interested in meeting individually with Dr. Kinzel, please contact Carly at 631-5431.