# Using 3D Printing for the Fabrication of Gas Dynamic Virtual Nozzles

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The Gas Dynamic Virtual Nozzle (GDVN) is a liquid droplet injector critical for the successful imaging of particles during Serial Femtosecond Crystallography (SFX). The nozzle uses helium gas to focus a jet of liquid to a small diameter while maintaining capillary diameters large enough to minimize the risk of clogging. The construction of these nozzles is a difficult and time-consuming process requiring grinding, flame-polishing, and mounting of polyimide-coated fused-silica capillaries. The recent development of two-photon polymerization (2PP) 3D printers has provided an opportunity for new methods of nozzle production, however early applications of this technology based on traditional nozzle designs have still required complex and difficult assembly methods and have typically exhibited high rates of failure following nozzle assembly. The use of 2PP technology, however, allows for the exploration and development of structures which were unobtainable using previous assembly techniques. Specifically, 2PP technology allows for a design that removes the need for nested capillaries, which has been the most difficult aspect of nozzle assembly for all previous 3D-printed designs. The purpose of this research is to present a new GDVN design using high-resolution 2PP 3D printing which substantially reduces the time and effort required for assembly while maintaining the reliability of nozzle performance demonstrated in earlier 3D printed designs.