European XFEL Workshop

Opportunities for microfluidic devices at Free-Electron Lasers

Rigid Materials for Photolithography Based Rapid Microfluidic Mixing and sample Delivery

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Sample delivery at X-ray free Electron lasers is complex and challenging field that continues to demand innovation and development. Initial work over the past two decades has firmly established the use of Gas Dynamic Virtual Nozzles (GDVN's) as an excepted standard for liquid sample injection. Current fabrication techniques associated with fused silica capillaries for the formation of GDVN's requires a highly manual fabrication process and has limited success rates and issues with reproducibility. In addition the use of fused silica capillaries restricts the possible combinations of geometry to sets of linear concentric channels.

Photolithography affords the advantages of parallel processing of multiple devices, high precision and reproducibility and also enables the formation of complex 2D and pseudo 3D geometries. To date the application of photolithography to the fabrication of GDVN's remains small even though success in planar PDMS devices has been demonstrated. This is in part due to the inherent limitations of PDMS as an elstomeric polymer, resulting in restrictions on the accessible working pressures and UHV compatibility issues.

In this presentation I will discuss the advantages and challenges associated with the fabrication of mixing devices and psuedo 3D structures in rigid materials including Silicon, Glass and SU-8. Some attention will also be given to potential methods for achieving rapid mixing in microfluidic systems.