Novel Method for Development of Nanobubbles with Consistent Size Distribution

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Background/Objective:

Ultrasound is a versatile non-invasive clinical tool that can be used for monitoring, diagnosis, and management of disease. Contrast-Enhanced Ultrasound (CEUS) takes advantage of microbubbles which are small gas filled bubbles made of lipids to image and evaluate functioning of organs such as the heart, liver, and kidneys. CEUS is better for assessing vascularization of tissues compared to US. However, ultrasound contrast agents have been limited by their size and cannot extravasate blood vessels easily. Current methods also have high polydispersity. We hypothesize that a microfluidic device could deliver nanobubbles with improved size distribution by mixing through micro sized pores.

Methods:

The microfluidic device was fabricated using 3D printing for a proof of concept and photolithography for functional use and was done in a class 1-10-100-1000 cleanroom. SU-8 photoresist was spun onto a 4" silicon wafer at 3000 rpm for 30 seconds. The silicon wafer was then baked and exposed under UV with a photomask designed on AutoCAD. The wafer was then developed, hard baked, and was cross linked with Polydimethylsiloxane (PDMS).

Results:

Dynamic light scattering data of a shaken formulation shows a monodisperse distribution. Further work will have to be done to determine if this can be delivered by microfluidic device and the parameters that affect size and polydispersity.

Conclusion and Potential Impact:

This study will determine the parameters needed for the microfluidic device to efficiently create microbubbles for contrast enhanced ultrasound.