Abstract:
Nanofluidic structures promise to solve the sample preparation problem in various spectroscopy experiments. The thickness of the sample is mostly constrained by the penetration depth of the optical probe. We have designed and successfully fabricated a nanofluidic cell which was used in a 2D-IR spectroscopy experiment to study the nature of the OH bond in water [1].

The building blocks of the cell are two low stress low-pressure chemical vapor deposition (LPCVD) silicon nitride membranes, created independently on separate wafers using wet etching of silicon. In the first generation cell, the membrane thickness was 800 nm. In the latest version, the thickness of the membrane was decreased to 200 nm in order to reduce the background signal in the experiment. A 500 nm layer of plasma enhanced chemical vapor deposition (PECVD) silicon oxide is deposited on top of one of the silicon nitride membranes. Reactive ion etching was then used to carve out a container and a channel into the silicon oxide layer. This step involves backside alignment in order to match the fluidic features with the existing membrane. The choice of silicon oxide is due to the hydrophilic nature of the material [2]. The other membrane served as a capping layer which was overlapped with the container using a custom made mechanical system. The resulting cell structure can be filled from the sides through the channels then sealed, trapping the sample inside.

Summary:
Thin-walled fluidic cells with high aspect-ratio containers were fabricated. The current smallest achieved wall thickness is 200 nm, with a 500 nm gap in between walls.

References:
Fabrication of Thin-Walled and High-Aspect-Ratio Microfluidic Channels

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• Free standing silicon nitride membranes.
• Bonded substrates with nitride windows enclosing microfluidic channels.
• High-aspect ratio containers.

Figure 1:
Side view of two substrates joined to form a microfluidic cavity.

[Diagram showing different materials and labels: water, silicon nitride, silicon wafer, silicon oxide]