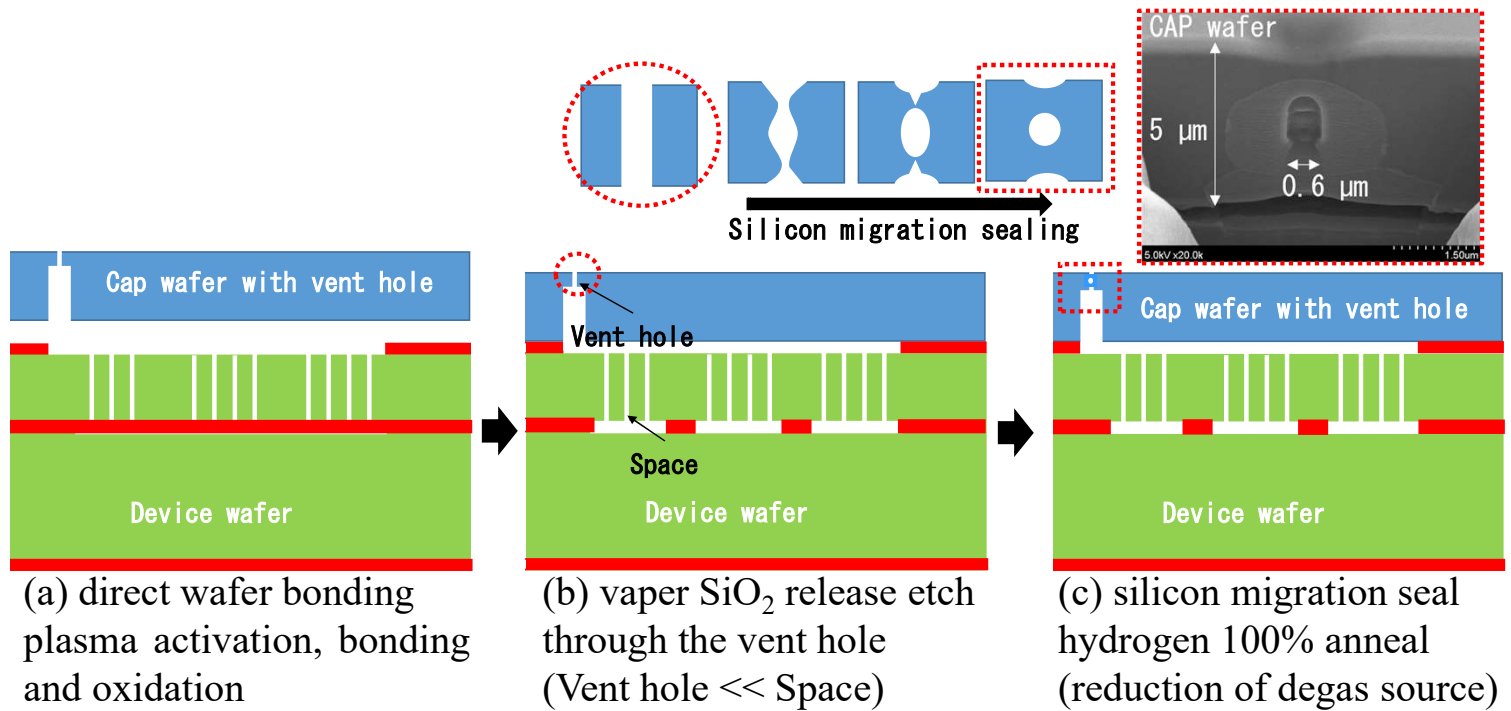
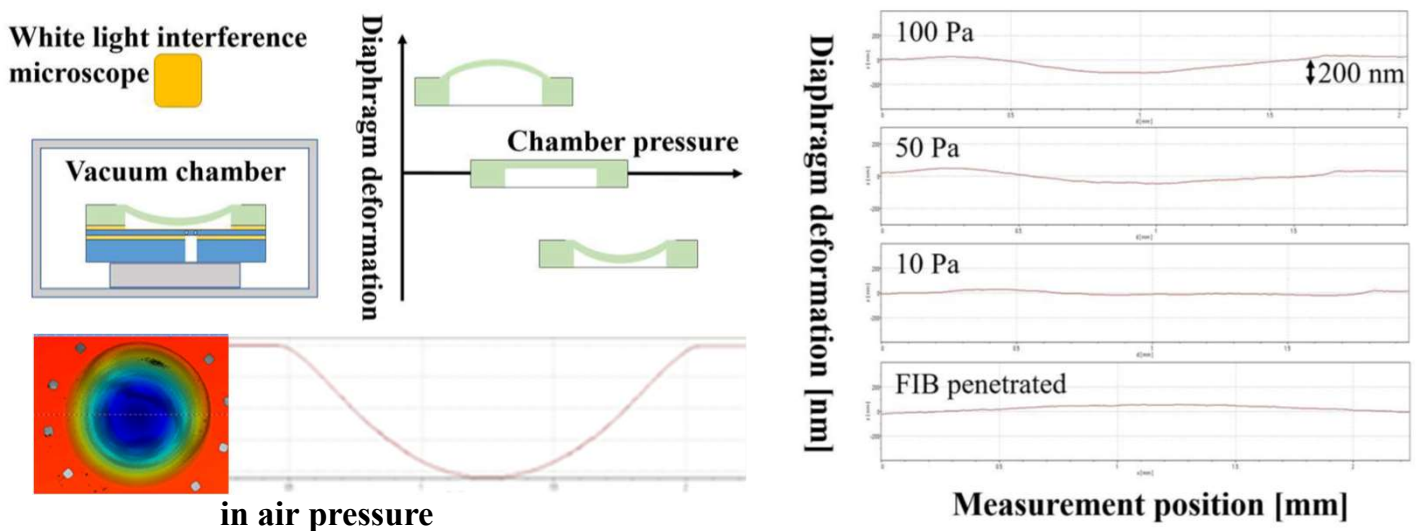


SMS(Silicon Migration Seal) vacuum package



For resonant MEMS, high vacuum sealing is an essential performance factor.

We propose SMS vacuum wafer level package, which not use deposition film and gettering material. Sealing part is made by single crystal silicon. Hydrogen reduction reaction to terminate degas source of sealed inside MEMS structure.



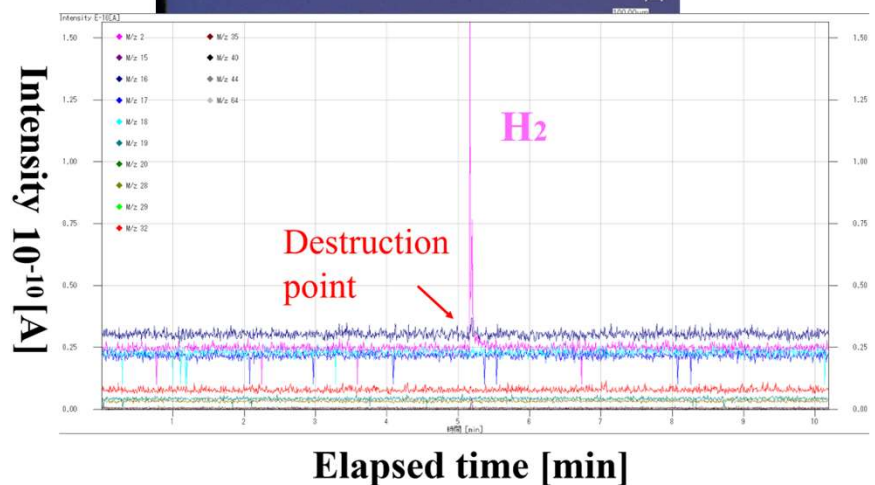
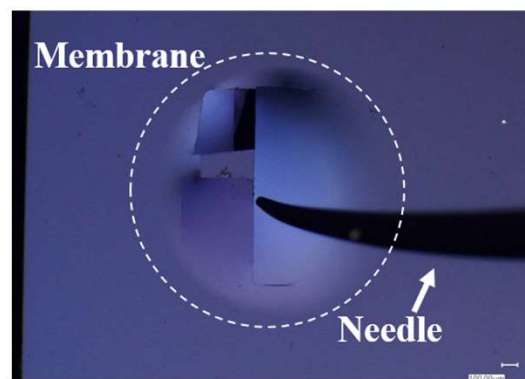
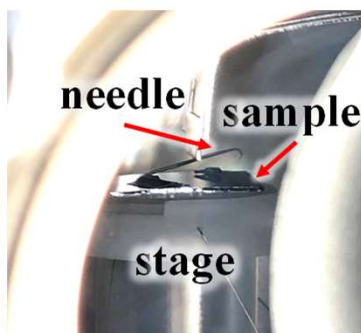
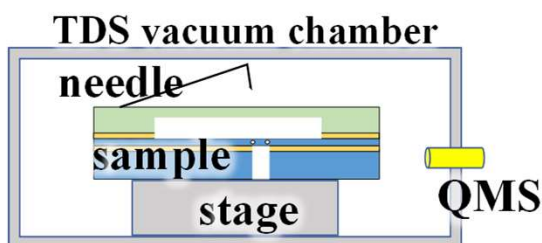
The sealing vacuum level was evaluated using silicon diaphragms fabricated in a device wafer. The SMS samples were placed in a vacuum chamber with calibrated pressure gauge to evaluate vacuum level of the sealed cavity. The vacuum level got better than the detection limit of about 10 Pa after few dozen hours annealing in nitrogen, during which hydrogen gas diffused out.

The residual gas inside sealed cavity of the sample was evaluated.

Thermal desorption spectroscopy (TDS) was used for the evaluation to analyze ionic species and their quantities.

A tungsten needle was attached to membrane of SMS sample alignment between tip of needle and membrane center. And the sample was brought into the vacuum chamber of TDS equipment, which has quadruple mass spectrometer (QMS).

First, the vacuum was reduced to the -7^{th} power level. Then, the needle was brought into contact with the sample by pushing it, after starting the QMS detection.



The value of M/z_2 was rapidly increased just after the membrane destruction from background level. There was hydrogen gas as residual gas inside sealed cavity. And no other degas was detected.

Higher vacuum sealing can be possible for SMS by efficient hydrogen gas diffusion from sealed cavity.

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