

**Wrinkling Evolution of a Growing Bubble
: The Wonders of Petallike Patterns in amorphous silicon Membranes**

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<Supplementary information>

To understand the fundamentals on the instability of ultrathin amorphous silicon (a-Si) membranes during their detachment from oxidized wafers through wet etching of the sacrificial silicon dioxide (SiO₂) layer, *in-situ* observation using an optical microscope was conducted throughout the entire process. Free a-Si membranes with various thicknesses from 200 to 400 nm were obtained through etching the wafer by submerging the samples into aqueous 49:51 HF/H₂O etchant that penetrate the structure of a-Si. Interestingly, it has been found that during the initial stages of the detachment process, distinct peripheral petallike wrinkles with facets were engendered of which their shapes differed depending on the thicknesses of the a-Si membranes. In the provided supplementary materials, three video clips are presented which show the development of such patterns for 200, 300, and 400 nm a-Si membranes during the early phases of the detachment process, before they merge with the neighboring patterns to form buckled structures.

Contents: 3 video clips

1. 200nm a-Si membrane detachment movie file.mpg
2. 300nm a-Si membrane detachment movie file.mpg

3. 400nm a-Si membrane detachment movie file.mpg

Descriptions:

1. Development of a peripheral petallike pattern in 200 nm-thick amorphous silicon membranes during the wet etching of SiO₂-based sacrificial oxide. HF reacts with the sacrificial oxide layer and the generated byproducts exert an uplifting force that creates a shape of a tiny bubble first. Then, the bubble gradually turns into a symmetrical, petallike pattern with facets as the etching time increases to relieve the mechanical stress and membrane energy. Due to the different etching rate and mechanical properties of the a-Si membranes with larger thicknesses, similar process yet with a different shape of patterns is observed for 300 and 400 nm-thick samples.
2. Development of a peripheral petallike pattern in 300 nm-thick amorphous silicon membranes during the wet etching of SiO₂-based sacrificial oxide.
3. Development of a peripheral petallike pattern in 400 nm-thick amorphous silicon membranes during the wet etching of SiO₂-based sacrificial oxide.