Development of transfer free SiNx membrane on insulating substrate for solid state nanopore

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Since the introduction of nanopore perforation by focused e-beam (FEB) in transmission electron microscopy (TEM), sub-10nm solid-state nanopore in silicon nitride membrane on Si substrate has been universally adopted in nanofluidic device for biomolecule sensing as an alternative to protein nanopore. Solid-state nanopore on Si substrate is known to exhibit high noise characteristics (I_{RMS} ~ 100 pA) compared to protein nanopore on lipid bilayer (I_{RMS} ~ 10 pA) despite their mechanical and process advantages. This is one of the big barriers that cannot increase the signal resolution of solid-state nanopore. In order to overcome this problem, some efforts have been made to insert a thick SiO_2 layer over 1 micrometer as a low-k material or cover it with a PDMS. We have been developed the formation process of SiNx membranes on low-k insulting substrates such as Pyrex. Up to now, we have transferred LPCVD SiNx to a Pyrex substrate with micrometer-sized holes, similar to the graphene transfer method. [2] In the wet transfer method, it is impossible to mass-produce chips due to chip-by-chip processes and so the consistency of performance for each chip cannot be guaranteed. Therefore, we have studied the process of forming SiNx membrane on an insulating substrate without transfer process and successfully implemented it. In this presentation, we describe the formation process of SiNx membrane on Quartz substrate and their properties in detail. We used the Quartz substrate to form the high quality SiNx thin film by LPCVD and double amorphous layer as a protection layer of SiNx membrane during the etch process.

References

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