Atomic Layer Etching with Ion/Neutral Beam

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Atomic layer etching is a fabrication technique that can etch materials layer-by-layer precisely in an atomic layer scale for next generation nanoscale semiconductor devices. The current etch technology utilizing reactive ion etching does not have precise etch rate/etch depth controllability and tends to damage the surface of the semiconductor devices physically and electrically due to the use of energetic reactive ions to achieve vertical etch profile.

The atomic layer etching can be applied to various materials not only the crystalline semiconductor materials such as Si, GaAs, etc. but also amorphous semiconductor materials such as SiO_2, HfO_2, etc. In addition, the atomic layer etching can be more attractive for future generation nanoelectronic devices utilizing two dimensional materials such as transition metal dichalcogenide (TMD) materials.

In this tutorial, atomic layer etching techniques with ion or neutral beam carried out by adsorption of reactive gas followed by an Ar (ion and neural) beam irradiation for the removal of a certain thickness per etch cycle similar to atomic layer deposition will be given. These atomic layer etching methods can be more applicable to various deep nanoscale semiconductors requiring a high aspect ratio etching, low temperature processing, etc. Finally, possible applications of atomic layer etching utilizing ion/neutral beam for the next generation device fabrication will be suggested.