

# Etch profile control of ALD-SiO<sub>2</sub> film assisted by alternating ALE process of fluorocarbon deposition and O<sub>2</sub> plasma etching

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It is demanded to form not only conformal film by ALD but also any desired shape on patterned structures with the assistance of ALE for advanced devices fabrication. We have recently developed a novel ALE of SiO<sub>2</sub> based on alternating process of fluorocarbon deposition and O<sub>2</sub> plasma etching, which features saturated etching thickness per cycle for both the fluorocarbon deposition time and O<sub>2</sub> plasma etching time. In this time we demonstrate the profile control of ALD SiO<sub>2</sub> film by controlling etch conformality of this ALE process.

Conformal SiO<sub>2</sub> film is deposited on a Si trench by plasma-enhanced ALD and then followed by the ALE with 60 MHz CCP type etching chamber. We investigate the etch conformality (EC) which is defined as the ratio of the etched thickness of sidewall film and that of top film with varying the ALE process parameters. A standard condition results EC of 33% as shown in Figure 1, which shows relatively anisotropic etching. On the other hand, a different condition using Ar/O<sub>2</sub> as the etching plasma gas instead of O<sub>2</sub> plasma shows EC of >100%, where sidewall film is etched while almost no etching on top film. This is because more carbon polymer is formed only on top due to anisotropic ion bombardment and it prevents etching top SiO<sub>2</sub> film. EC can be controlled depending on plasma gas and further tuned by varying process parameters such as pressure, RF power, and substrate bias.

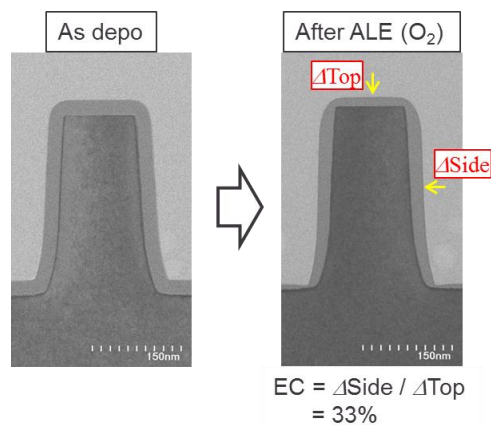


Fig.1. Etching conformality (EC) of a standard ALE condition.