Comparative Study of ALD SiO_2 films

SiO_2 is a widely used and studied dielectric material for electronic and optical applications, such as in spacer defined multi-patterning, shallow trench isolation (STI), liners, and antireflection coatings.

ALD is a very appropriate deposition technique to be used for those applications due to its extreme good thickness control, uniformity and conformity. In the case of spacer-defined multi patterning, ALD's low deposition temperatures (below 100 °C) allow direct deposition on organic materials like photoresist or SiC films. While for other application, allowing more elevated deposition temperatures, high temperature ALD films might be beneficial due to modified film quality (e.g. etch resistance).

For throughput reasons fast deposition rates, i.e. high growth per cycle (GPC), are important. As presented in previous work, the GPC of a bis-substituted silane, such as SAM.24, can be outperformed while moving to precursors having more Si atoms in their molecular backbone (e.g. aminodisilanes).

A spectacular increase in GPC is achieved with Si rich precursors such as New SAM. Both, at low (~70°C) and at high (~300 °C) deposition temperatures the GPC is more than doubled as compared to the reference compound, SAM.24. The observed decrease of the GPC with increasing deposition temperature is well explained by the reduced number of -OH bonds at elevated temperature [1].

In this study the self-limiting growth rate of different precursors is studied at elevated deposition temperatures (250 °C-450 °C). In addition to the precursor / process parameters, material properties of the resulting films, including thickness uniformity, etching rates, and stoichiometric composition, are presented in this paper.

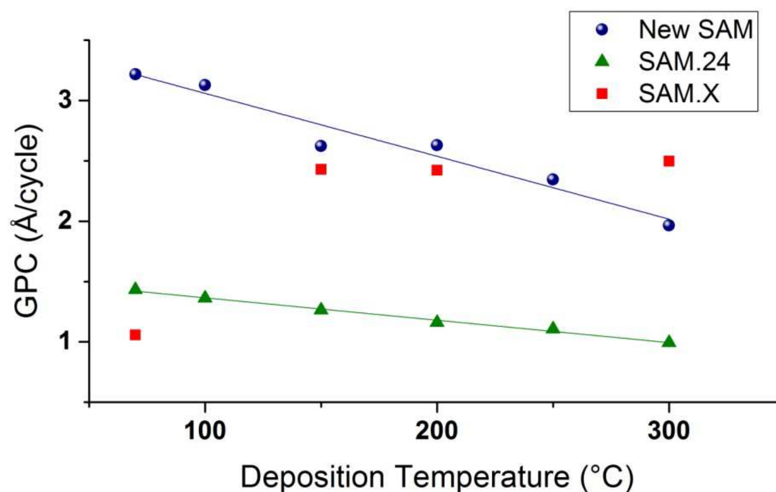

Figure 1: GPC vs temperature for PEALD SiO_2 using SAM.24, New SAM, SAM.X.

[1] G. Dingemans, C. A. A. van Helvoirt, M. C. M. van de Sanden, and W. M. M. Kessels, ECS Transactions, 35 (4) 191-204 (2011)