Low-Carbon Silicon Oxynitride Films with Trisilylamine

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Silicon oxynitride (SiON) has better barrier properties than silicon oxide (SiO_x) and better transmittance properties than silicon nitride (SiN_x).[1] Good SiON properties are required in various industrial fields such as semiconductors, organic light emitting diodes (OLEDs) and solar cells. One of the requirement for good SiON films is low carbon impurities.[2] However, most of conventional precursors are carbon-containing precursors such as hexa-methyldisilazane (HMDS), bis(tertiarybutylamino)-silane (BTBAS), tris(dimethyl-amino)silane (TDMAS), etc.[3] In this study, trisilylamine (TSA), a carbon free precursor, was used to deposit SiON by both plasma enhanced chemical vapor deposition (PECVD) and plasma enhanced atomic layer deposition (PEALD) with minimal carbon impurities. SiON with TSA had less than 3% carbon. Compared to the conventional precursors (BTBAS, TDMAS), there was a difference in carbon content of more than 10% points. The carbon bonding state in the films was identified as C-H bonding mostly, or hydrocarbon (C_xH_y) functional groups contained in the conventional precursors. As the carbon content increased, the silicon and nitrogen contents decreased and Si-N bonds decreased. This study suggests that TSA, a carbon free precursor, may be a suitable precursor for the deposition of SiON films having improved film density.

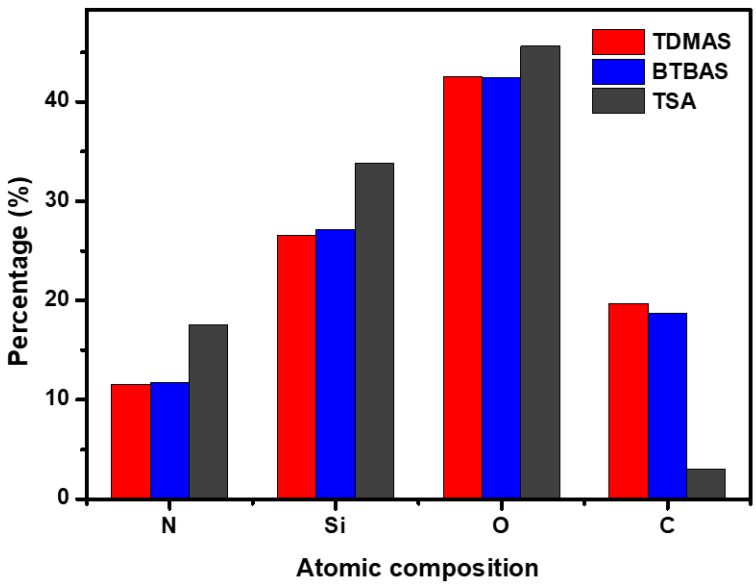

Fig. 1 Atomic composition percentage of SiON films with TDMAS, BTBAS or TSA

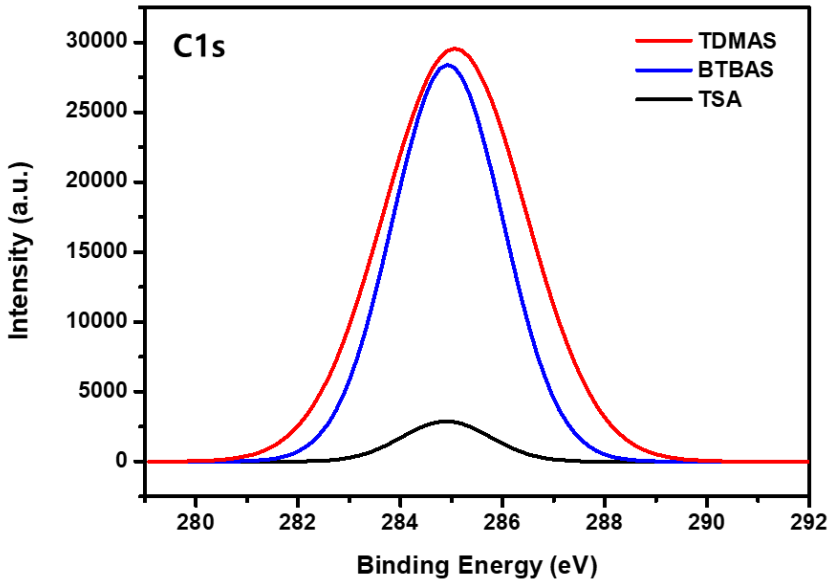

Fig. 2 XPS C1s spectra of SiON films with TDMAS, BTBAS or TSA

References:

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