Room-Temperature Deposition of Silicon Nitride Films with Very High Rates Using Atmospheric-Pressure Plasma Chemical Vapor Deposition

HIROAKI KAKIUCHI, HIROMASA OHMI, KIYOSHI YASUTAKE, Osaka University — We have investigated the structure and stability of SiN$_x$ films deposited with very high rates (>50 nm/s) in atmospheric-pressure (AP) He-based plasma excited by a 150 MHz very high-frequency (VHF) power using a cylindrical rotary electrode at room temperature. The SiN$_x$ films are prepared on Si(001) substrates with varying VHF power density ($P_{VHF}$), H$_2$ concentration and source ratio (NH$_3$/SiH$_4$). The results show that increasing H$_2$ concentration under the supply of a moderately large $P_{VHF}$, together with the adjustment of NH$_3$/SiH$_4$ ratio, enables us to prepare SiN$_x$ showing reasonable stability against a buffered hydrofluoric acid solution in spite of the very high deposition rate of 130 nm/s. The achievement of such a high-rate deposition at room temperature is primarily due to the significant enhancement of both gas-phase and surface-phase reactions in AP-VHF plasma.

Hiroaki Kakiuchi
Osaka University

Date submitted: 08 Jun 2010