CVD Parylene-N as pore sealant for porous low-κ dielectrics

by

Jasbir Singh Juneja

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Examining Committee:

Toh-Ming Lu, Thesis Co-Adviser
Hassaram Bakhru, Thesis Co-Adviser
Joel L. Plawsky, Member
Ravindra S. Kane, Member
Ishwara Bhat, Member

Rensselaer Polytechnic Institute
Troy, New York

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ABSTRACT

Ever increasing speed of IC processors is forcing the semiconductor industry to shift to porous low-k dielectrics. Important challenges lie in understanding the interaction of porous low-k with conventional IC processes, like plasma interactions and deposition of thin film on porous low-k which currently cause reliability problems. Pore sealing has become key to obtain acceptable reliability performance of interconnects. This work examines the use of chemical vapor deposited Parylene-N as a pore sealant for porous low-κ material to enable the integration of porous dielectrics into the current integrated circuits. The enhancement of electrical and mechanical properties porous dielectrics after pore sealing is investigated. Methyl silsesquioxane (MSQ) with varying porosity is used as the porous low-κ material for investigation.

Thin Parylene films (10-50 Å) have been shown to work as pore sealant on various porous low-κ materials. Various techniques have been used to test for pore sealing, like RBS after ALD/CVD precursor exposure, TEM/EELS and PALS. Parylene penetrates into the porous dielectric while pore sealing resulting in an unwanted increase in the dielectric constant of the porous dielectric. Parylene penetration into porous low-κ is measured using Nuclear reaction analysis of carbon. Parylene penetration is controlled using various process parameters. Dielectric constant and RC delay after Parylene pore sealing have been controlled within 5% of control samples.

Parylene pore sealing improves electrical properties leakage current, breakdown field and time dependent dielectric breakdown. Pore sealing is also shown to suppress copper drift and organics uptake. Pore sealed low-κ is shown to have higher fracture strength than bare low-κ.