

Ultrathin Film Deposition by Liquid CO₂ Free Meniscus Coating – Uniformity and Morphology

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Ultrathin organic films of sucrose octaacetate (SOA) were deposited on 12.5 cm diameter silicon wafer substrates using high-pressure free meniscus coating (hFMC) with liquid CO₂ (l-CO₂) as a coating solvent. The dry film thickness across the wafer and the morphology of deposited films were characterized as a function of coating conditions – withdrawal velocity, solution concentration and evaporation driving force (ΔP). When no evaporation driving force was applied ($\Delta P = 0$), highly uniform films were deposited with thickness in the range of 8–105 Å over the entire concentration range (3–11 wt%). However, films deposited at medium to high concentrations (7–11 wt%) were thicker (110–570 Å) and less uniform, with larger non-uniformities at higher applied evaporation driving forces. Optical microscopy and atomic force microscopy (AFM) were used to characterize film morphology including drying defects and film roughness. Films deposited without evaporation had no apparent drying defects and very low root mean square (RMS) roughness (1.4–3.8 Å). Films deposited from l-CO₂ hFMC were much thinner, more uniform, and exhibited much fewer drying defects and lower RMS roughness.