

Abstract Submitted
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Nucleation and Growth of ALD Hafnium Oxide High-k Dielectric Films by GISAXS. ANDREW ALLEN, NIST, MARTIN GREEN, NIST — Atomic layer deposition (ALD) is an important film growth technique that enables accurate growth of ultrathin layers for high-k gate dielectrics. Results will be presented of grazing incidence small angle x-ray scattering (GISAXS) studies of the nucleation and growth of ALD hafnium oxide films. The scattering is related to surface roughness and internal interfaces within the films, resulting from film coalescence of the nuclei. Films grown on H-terminated Si are rough and nonplanar, exhibit greater scattering, and have greater internal surface area than films grown on chemically oxidized Si. These films have 5 times the internal surface area of films grown on chemically oxidized Si, and may be significantly porous. The characteristic scattering features are the film nuclei, which coalesce and become inherited features of the films. The nuclei size is about 2 nm, consistent with TEM observations. Films grown on chemically oxidized Si reach coalescence at about 25 cycles, or 1.3 nm thickness, consistent with electrical data. Implications arising from the different film morphologies discussed.

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