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Observation of heterodyne and homodyne mixing in X-ray photon correlation spectroscopy during thin film deposition[1]
RANDALL HEADRICK, JEFFREY ULBRANDT, University of Vermont, MELIHA RAINVILLE, CHRISTA WAGENBACH, Boston University, SURESH NARAYANAN, ALEC SANDY, HUA ZHOU, Argonne National Laboratory, KARL LUDWIG, Boston University — The properties of artificially grown thin films are often strongly affected by the dynamic relationship between surface growth processes and subsurface structure. Coherent mixing of X-ray signals promises to provide an approach to better understand such processes. Continuously variable mixing of surface and bulk scattering signals during real-time studies of sputter deposition of a-Si and a-$WiSi_2$ films has been observed by controlling the X-ray penetration and escape depths in coherent grazing incidence small angle X-ray scattering (Co-GISAXS). Under conditions where the X-ray signal comes from both the growth surface and the thin film bulk, oscillations in temporal correlations arise from coherent interference between scattering from stationary bulk features and from the advancing surface. The absence of oscillations at larger in-plane wavevector transfer is interpreted as evidence that elongated bulk features propagate upward at the same velocity as the surface. Additionally, a highly surface sensitive mode is demonstrated that can access the surface dynamics independently of the subsurface structure.

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