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Pulsed Laser Deposition of $SrTiO_3$ Thin Films: Time-Resolved X-ray Studies[1] JOEL BROCK, GOKHAN ARIKAN, JOHN FERGUSON, ARTHUR WOLL, Cornell University — X-ray scattering and reflectivity have been used to measure the static atomic structure of surfaces and interfaces for several decades. Modern synchrotron x-ray facilities now deliver sufficient flux to make time-resolved measurements on a wide variety of evolving surface and interface systems feasible. Here, we use time-resolved x-ray diffuse scattering studies of Pulsed Laser Deposition (PLD) of $SrTiO_3$ films on the (001) surface of $SrTiO_3$ to obtain detailed insight into the fundamental, atomic-scale growth mechanism. The data demonstrate that during layer-by-layer growth, islands are nucleated during the 1^{st} pulse. The size of the pulse determines the nucleation density. During and in between subsequent pulses, the islands coarsen and coalesce. Line shape analysis of the diffuse scattering reveals that adatom capture occurs at the same time as coarsening. The time-resolved x-ray data obtained as a function of miscut further demonstrate that kinetic growth models based on adatom diffusion on singular surfaces are missing essential physical mechanisms which are step-edge density dependent.

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