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Quantum Growth of a Metal/Insulator System HAWOONG HONG, Argonne Natinoal Laboratory, AARON GRAY, University of Illinois at Urbana-Champaign, RUQING XU, Argonne National Laboratory, LONGXIANG ZHANG, TAI-C. CHIANG, University of Illinois at Urbana-Champaign — Quantum confinement of electrons in thin metal films can lead to novel effects on the growth, structure, stability, and various other physical and chemical properties, as demonstrated by recent work on metal films grown on semiconductor substrates. We report herein the observation of quantum growth behavior in a metal-on-insulator system; the results show substantial differences. Insulating substrates, with their large band gaps, offer minimal electronic coupling at the interface. This decoupling should maximize quantum confinement effects. Indeed, in a study of Pb film growth and thermal processing on sapphire, we have observed robust preferred island height selection over a wide thickness range – a hallmark of quantum confinement effects – for processing temperatures up to 250 degrees C. By contrast, room temperature is the limit for Pb films prepared on the semiconducting substrate Si(111). These results provide the first evidence connecting the quantum growth behavior of overlayers with the substrate band gap.

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