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Transitions from single-layer MoS_2 to bilayer growth: A LEEM study — •Moritz Ewert[1,2,3], Lars Buss[1,2], Francesca Genuzio[4], Tevfik Onur Menteş[4], Andrea Locatelli[4], Jens Falta[2,3], and Jan Ingo Flege[1,2,3] — [1]Applied Physics and Semiconductor Spectroscopy, Brandenburg University of Technology Cottbus-Senftenberg, Germany — [2]Institute of Solid State Physics, University of Bremen, Germany — [3]MAPEX Center for Materials and Processes, University of Bremen, Germany — [4]Elettra-Sincrotrone Trieste S.C.p.A., Basovizza, Trieste, Italy

Molybdenum disulfide (MoS_2) is well-known to change from an indirect to a direct semiconductor as a single layer.
We present insights from in-situ low-energy electron microscopy (LEEM) on the extended growth of MoS_2 on the Au(111) surface at elevated temperatures of 720°C. Our continuous growth method leads to the formation of micron-sized single-layer MoS_2 islands. The single-domain character of these islands is confirmed by employing dark-field imaging and micro-diffraction (LEED). This also reveals the distribution of 90:10 of the two expected MoS_2 mirror domains on Au(111). Selected-area angle-resolved photoelectron spectroscopy (ARPES) measurements of these mirror domains underline the three-fold symmetry of the two mirror domains and indicate the presence of MoS_2 bilayer. Using X-ray photoemission electron microscopy (XPEEM) and intensity-voltage LEEM (I(V))-LEEM we identify the bilayer nucleation areas at nearly full surface coverage and propose a model pathway for their formation.

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