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In-situ growth and characterization of 2D TaSe₂ on Au(111)

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Group V dichalcogenides such as TaX₂ (X = S, Se, T) have extensively been investigated in recent decades due to their diverse electron correlation effects, including the occurrence of charge density waves and Mott-Hubbard transitions. In 2D, two polytypes, 1T and 1H, exist, which exhibit distinct properties, making selective growth of each polytype crucial. Using low-energy electron microscopy (LEEM), we have successfully observed the growth of two TaSe₂ phases on Au(111) *in situ* after the co-deposition of Ta and Se. At elevated temperature, micron-sized, triangle-shaped islands with bright contrast nucleate first and grow at a higher rate. However, this phase turns out to be metastable as it suddenly transitions into a more stable phase (with dark contrast) and continues to grow at a reduced rate. Low-energy electron diffraction shows the presence of TaSe₂; bandstructure-sensitive I(V)-LEEM analysis reveals substantial differences in electron reflectivity between both phases. A comparison with TaS₂ suggests that the metastable and stable phases are 1T- and 1H-TaSe₂, respectively.

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