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Inherently area-selective hot-wire assisted atomic layer deposition of tungsten films

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Abstract. This work demonstrates area-selective growth of tungsten (W) films by hot-wire assisted atomic layer deposition (HWALD). With this recently developed technique, low-resistivity alpha-phase W films can be deposited by using sequential pulses of atomic hydrogen (at-H) and WF_6 at a substrate temperature of 275 ºC. As reported in this article, the deposition is highly selective. HWALD tungsten grows with little to no incubation time on W, Co and Si surfaces. On the other hand, no growth is observed on TiN, Al_2O_3 and SiO_2 surfaces. The interfaces of W and various substrates are examined by transmission electron microscopy. The absence of oxygen in the interfaces indicates that the atomic-hydrogen not only serves as a suitable ALD precursor for W, but is here shown to effectively reduce the native oxides of W and Co at the ALD process conditions, enabling in situ surface preparation before starting the deposition sequence.

Keywords: Hot-wire atomic layer deposition; Inherently selective growth; Tungsten; transmission electron microscopy