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A super-cycle approach to atomic layer deposition of indium-gallium-zinc oxide at low temperature — Ali Mahmoodinezhad[1], Carlos Morales[1], Małgorzata Kot[1], Franziska Naumann[2], Paul Plate[2], •Karsten Henkel[1], and Jan Ingo Flege[1] — [1]Applied Physics and Semiconductor Spectroscopy, Brandenburg University of Technology Cottbus-Senftenberg, Germany — [2]SENTECH Instruments GmbH, Berlin, Germany

The continuing development of multifunctional devices needs novel multicomponent oxide layers, demanding a high control of both composition and thickness during their preparation. To this end, single metal oxides exhibiting high structural quality and conformity have successfully been grown by atomic layer deposition (ALD). However, the deposition of more complex compounds with specific optical and electrical properties is still challenging. In this work, we follow a bottom-up approach to design an ALD super-cycle to grow mixed indium-gallium-zinc oxide (IGZO) films with a controllable composition. For the formation of the individual indium, gallium, and zinc oxides, we found the use of plasma-enhanced ALD (PEALD) at 150 °C to be favorable when using the organometallic precursors trimethylindium, trimethylgallium, and diethylzinc together with oxygen plasma. The PEALD approach of IGZO films can particularly overcome a nucleation delay within the ZnO sub-cycle known from thermal ALD, achieving a higher growth per cycle and improving the quality and composition homogeneity of the films as shown by in-situ spectroscopic ellipsometry and ex-situ X-ray photoelectron spectroscopy.

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Email: henkel@b-tu.de