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Room temperature magnetron sputtering of InGaZnO and ZTO amorphous oxide semiconductors

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Amorphous oxide semiconductors (AOS) have attracted a great deal of attention as they offer a combination of interesting properties, namely high carrier mobility along with high optical transparency, mechanical flexibility as well as smooth surface. AOS are thus suitable for transparent flexible electronics such as thin-film transistors or/and flat-panel displays. Another key advantage is the fact that AOS can be prepared at low temperatures large area deposition techniques such as magnetron sputtering on the flexible substrates. Although In-Ga-Zn-O has the best performance so far, there is an interest in In-free alternatives.
The properties of AOS are extremely sensitive to the deposition conditions, stoichiometry and composition, giving rise to a wide range of tunable optical and electrical properties. In this work we examined the effect of different discharge configurations to identify the relation between growth conditions and properties of magnetron sputtered InGaZnO(IGZO) and ZnSnO(ZTO) films. IGZO films were deposited by RF sputtering from an oxide target while for ZTO, reactive sputtering from an alloy target was used. The changes of chemical composition, structure, electrical and optical properties of IGZO and ZTO films dependent on the lateral substrate position have been analysed by Hall measurements, Raman, XPS and UV-Vis spectroscopy. The a-IGZO films deposited by rf sputtering showed a large variation in resistivity, Hall mobility and carrier concentration. The best as-deposited IGZO films had resistivity of about 2·10-2 Ohm·cm and electron mobility up 10 cm2·V-1·s-1. The lateral property gradients are discussed with respect to the composition and energy of the material flux towards the substrate and major effect of oxygen and gallium ions is demonstrated.

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