Rapid solution process for high performance and stable Amorphous Metal Oxide Thin Film Transistors by Water Vapor Annealing

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Here we report on a simple and high-rate oxidization method for producing solution-based compound mixtures of IZO and IGZO metal-oxide semiconductors (MOS) for thin-film transistor (TFT) applications. One of the issues for solution-based MOS fabrication is how to sufficiently oxidize the precursor in order to achieve high performance[1]. As the oxidation rate of solution processing is lower than vacuum-based deposition such as sputtering, devices using solution-processed MOS exhibit relatively poorer performance[2]. Therefore, we propose a method to prepare the metal-oxide precursor upon exposure to saturated water vapor in a closed volume for increasing the oxidization efficiency without requiring additional oxidizing agent. We found that the hydroxide rate of the MOS film exposed to water vapor is lower than when unexposed (≤18%). Hence, we successfully fabricated oxide TFTs with high electron mobility (27.9 cm2/V·s) and established a rapid process (annealing at 400 ℃ for 5min) that is much shorter than the conventional as-deposited long-duration annealing (at 400 ℃ for 1 hr) whose corresponding mobility is even lower (19.2 cm2/V·s). Also bias stress variation to less than 1% under constant operating voltage bias (V_G = 30V, V_D = 5V) condition.

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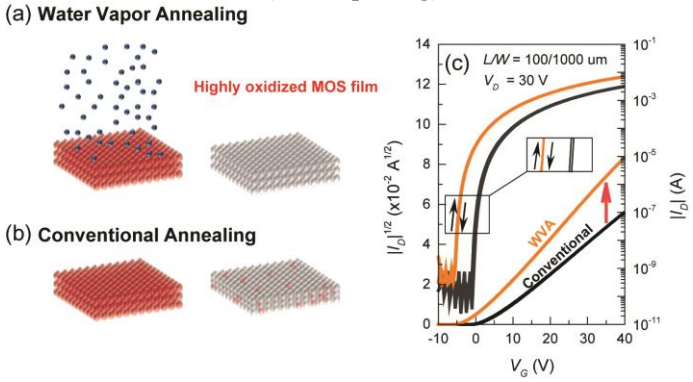

Fig. 1. Illustration of (a) WVA and (b) conventional metal-oxide semiconductor film formation processes and (c) transfer characteristic of TFT by following processed, respectively.

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