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PII: S0169-4332(17)31038-3
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2017.04.031
Reference: APSUSC 35706

To appear in: *APSUSC*

Received date: 6-3-2017
Revised date: 31-3-2017
Accepted date: 4-4-2017

Please cite this article as: J.-Y. Jeon, T.-J. Ha, Improvement in interfacial characteristics of low-voltage carbon nanotube thin-film transistors with solution-processed boron nitride thin films, *Applied Surface Science* (2017), http://dx.doi.org/10.1016/j.apsusc.2017.04.031

Improvement in interfacial characteristics of low-voltage carbon nanotube thin-film transistors with solution-processed boron nitride thin films

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Abstract

In this paper, we demonstrate the potential of solution-processed boron nitride (BN) thin films for high performance single-walled carbon nanotube thin-film transistors (SWCNT-TFTs) with low-voltage operation. The use of BN thin films between solution-processed high-k dielectric layers improved the interfacial characteristics of metal-insulator-metal devices, thereby reducing the current density by three orders of magnitude. We also investigated the origin of improved device performance in SWCNT-TFTs by employing solution-processed BN thin films as an encapsulation layer. The BN encapsulation layer improves the electrical characteristics of SWCNT-TFTs, which includes the device key metrics of linear field-effect mobility, sub-threshold swing, and threshold voltage as well as the long-term stability against the aging effect in air. Such improvements can be achieved by reduced interaction of interfacial localized states induced by oxygen or water molecules absorbed on the surface. We believe that this work can open up a promising route to demonstrate the potential of solution-processed BN thin films on nanoelectronics.

Keywords: Solution-processed boron nitride thin films, single-walled carbon nanotubes, low-voltage operation, interfacial characteristics, stability