2nd World Congress and Expo on
Nanotechnology and Material Science
April 04-06, 2016 at Dubai, UAE

Oxide Semiconductors for Transparent Electronics Applications

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In this presentation, we discuss recent work in our groupon p-type oxide semiconductors for transparent electronics applications. Careful process optimization was first carried out to establish a stable SnO film deposition process, which was subsequently used to fabricate thin-film transistors, nanowire transistors, CMOS devices, and a nonvolatile memory, all based on SnO channel layer.A detailed phase stability map for physical vapor deposition of SnO films is constructed, and SnO thin films with a Hall mobility as high as 18.71 $cm^2V^{-1}S^{-1}$were deposited. In addition, we have fabricated TFT devices with a linear field-effect mobility of 6.75 $cm^2V^{-1}S^{-1}$and 5.87 $cm^2V^{-1}S^{-1}$on transparent rigid and translucent flexible substrates, respectively.P-type tin monoxide (SnO) nanowire field-effect transistors with stable enhancement mode behavior and record performance are demonstrated at 160°C. The nanowire transistors exhibit a field-effect hole mobility of 10.83$cm^2V^{-1}S^{-1}$, which is higher thanany p-type oxide semiconductor processed at similar temperature. Compared to thin film transistors, the SnO nanowire transistors exhibit five times higher mobility, and one order of magnitude lower subthreshold swing. The SnO nanowire transistors show three times lower threshold voltages (-1 Volt) than the best reported SnO thin film transistors, and fifteen times smaller than p-type Cu_2O nanowire transistors. Recent results from CMOS and hybrid memory devices based on SnO will also be discussed.

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Biography:

Dr. Husam Alshareef is a Professor of Materials Science & Engineering at King Abdullah University of Science &Technology (KAUST). His research is focused on the development of semiconductor nanomaterials and processes for energy and electronics. The author of more than 275 articles, he has nearly 80 patents. He has won the UNDP Undergraduate Fellowship, Seth Sprague Physics Award, North Carolina State Dean's Fellowship, U.S. Department of Education Electronic Materials Fellowship, and the SEMATECH Corporate Excellence Award. He served as co-chair for the 2014 Materials Research Society (MRS) Fall Meeting, and is asenior member of IEEE.