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High-Performance ZnO Nanowire FETs PAI-CHUN CHANG, ZHIYONG FAN, CHUNG-JEN CHIEN, JIA GRACE LU, University of Southern California — Zinc oxide (ZnO) nanowires have attracted tremendous interest due to their remarkable physical properties and versatile applications in electronic devices, such as logic circuit, UV emitter and photodetector, as well as chemical sensor. In the previous research report, ZnO nanowire configured as field effect transistor (FET) shows an electron mobility ranging from 3 to 80 $cm^2/V{\cdot}s$ without surface treatments. In order to optimize the performance of devices, it is crucial to improve the carrier transconductance and mobility in the nanochannel. In our work, single-crystalline ZnO nanowires were synthesized via a catalyst-assisted chemical vapor deposition method. Temperature dependent photoluminescence measurements demonstrate the evolution of peak intensities resulted from different radiative mechanisms. The sharp peak with its full-width half maximum of 3.6meV at 12 K and the absence of other bound-exciton lines indicate that the as-grown nanowires are of high crystal and optical qualities. Following CMOS compatible procedures to passivate surface defect states and also to reduce chemisorption processes, the nanowire FETs exhibit orders of magnitude improvement in the on/off ratio, sub-threshold swing and field effect mobility. Remarkable mobility exceeding 4000 $cm^2/$ V·s was estimated.

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