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Field-effect transistors based on Si:P nanowires with axially graded doping JORGE BARREDA, TIMOTHY KEIPER, MEI ZHANG, PENG XIONG, Florida State University — Phosphorus-doped Si nanowires (NWs) have been synthesized via the vapor-liquid-solid method. Local electrical transport measurements along the length of the NWs reveal a systematic reduction of the electrical conductivity in the growth direction. These results, along with structural characterizations by SEM and AFM, point to a graded doping profile along the length of the NWs [1] as the origin of the spatial variation of the electronic properties. Due to the inherent doping gradient, Cr/Au and Cr/Ag contacts on the NWs evolve systematically from ohmic contacts on the highly-doped side (where growth starts) to Schottky junctions on the lower-doped side (where growth ends). Field-effect transistors (FETs) have been fabricated from individual as-grown Si NWs. By patterning a series of electrodes along the length of a NW, both channel-limited and Schottky barrier-limited devices were obtained from a single NW. In particular, by using two electrodes located at opposite ends of a NW, FETs limited by a single Schottky junction were consistently realized. These devices, in which the Schottky junction acts as the drain terminal and the ohmic contact as the source terminal, exhibit excellent gate modulation due to the tuning of the Schottky barrier. [1] Daniel E. Perea et al., Nature Nanotechnology 4, 315-319 (2009).

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