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Single Schottky junction FETs based on Si:P nanowires with axially graded doping JORGE BARREDA, TIMOTHY KEIPER, MEI ZHANG, PENG XIONG, Florida State University — Si nanowires (NWs) with a systematic axial increase in phosphorus doping have been synthesized via a vapor-liquid-solid method. Silane and phosphine precursor gases are utilized for the growth and doping, respectively. The phosphorous doping profile is controlled by the flow ratio of the precursor gases. After the as-grown product is ultrasonically agitated into a solution, the Si NWs are dispersed on a SiO_2 substrate with a highly doped Si back gate. Individual NWs are identified for the fabrication of field-effect transistors (FETs) with multiple Cr/Ag contacts along the NW. Two-probe and four-probe measurements are taken systematically under vacuum conditions at room temperature and the contribution from each contact and each NW section between adjacent contacts is determined. The graded doping level, produced by a systematic reduction in dopant density along the length of the NWs [1], is manifested in the regular increases in the channel and contact resistances. Our Si NWs facilitate the fabrication of asymmetric FETs with one ohmic and one Schottky contact. A significant increase in gate modulation is obtained due to the single Schottky-barrier contact. Characterization details and the applicability for sensing purposes will be discussed.

[1] D. E. Perea et al., Nature Nanotechnology 4, 315 (2009).

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