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Patterning, Characterization and Chemical Sensing Applications of Graphene Nanoribbon Arrays Down to 5 nm Using Helium Ion Beam Lithography[1] AHMAD ABBAS, GANG LIU, BILU LIU, LUYAO ZHANG, HE LIU, University of Southern California, DOUGLAS OHLBERG, HP Labs, WEI WU, CHONGWU ZHOU, University of Southern California — Bandgap engineering of graphene is an essential step towards employing graphene in electronic and sensing applications. Recently, graphene nanoribbons (GNRs) were used to create a bandgap in graphene and function as a semiconducting switch. Although GNRs with widths of <10 nm have been achieved, problems like GNR alignment, width control, uniformity, high aspect ratios, and edge roughness must be resolved in order to introduce GNRs as a robust alternative technology. Here we report patterning, characterization and superior chemical sensing of ultra-narrow aligned GNR arrays down to 5 nm width using helium ion beam lithography (HIBL) for the first time. The patterned GNR arrays possess narrow and adjustable widths, high aspect ratios, and relatively high quality. Field-effect transistors were fabricated on such GNR arrays and temperature-dependent transport measurements show the thermally activated carrier transport in the GNR array structure. Furthermore, we have demonstrated exceptional NO2 gas sensitivity of the 5 nm GNR array devices down to ppb levels. The results show the potential of HIBL fabricated GNRs for the electronic and sensing applications.

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Ahmad Abbas
University of Southern California

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