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In-situ Fabrication and Electronic Characterization of Junction-confined Single Layer Graphene Nanoribbons[1] ZHENGQING JOHN QI, JULIO RODRIGUEZ-MANZO, University of Pennsylvania, SUNG JU HONG, Seoul National University, MARIJA DRNDIC, A.T. CHARLIE JOHNSON, University of Pennsylvania — We report electronic measurements on high quality single layer junction-confined graphene nanoribbons fabricated in a transmission electron microscope (TEM). In this work, a process is demonstrated for the fabrication and confirmation of pristine single layer graphene nanoribbons using high vacuum current annealing and precision nano-sculpting, both conducted within the vacuum chamber of a TEM. Briefly, CVD-grown graphene is patterned into a freely-suspended nanoribbon connected to large area contacts. The sample is then mounted on a TEM holder with electrical feedthroughs to allow for simultaneous imaging and in-situ electrical transport measurements within the TEM. A focused electron beam is used to progressively narrow the ribbon, providing a platform to controllably sculpt and define the device geometry while characterizing its electrical properties. In-situ electrical measurements and TEM imaging with sub-nm resolution revealed the dependence of the nanoribbon resistance as a function of width in the range 17 – 280 nm. Monolayer graphene were found to sustain current densities in excess of 5 x 10^9 A/cm^2, orders of magnitude higher than copper while the conductance varied approximately as $w^{0.75}$, where w is the ribbon width in nanometers. These results demonstrates graphene's potential as a next generation, high performance interconnects material with the ability to reach single-digit technology nodes at the level of a single atomic layer.

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