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Local Probe Measurement of Atomically-Engineered Graphene Nanostructures

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Graphene's unique electronic properties give rise to novel defect behavior at impurities and at edges. This can be seen in graphene's response to charged impurities, where graphene's ultra-relativistic nature leads to impurity states that are unlike those found in any other material. We have explored such impurity states across different impurity-charge regimes by building artificial charge centers (i.e., "artificial nuclei") atom-by-atom at the surface of graphene devices and probing them via scanning tunneling microscopy. New results on this topic, including the observation of "atomic collapse", will be discussed. The properties of graphene's edges become increasingly important when graphene is cut into nanoscale structures having sharp boundaries. While such structures are difficult to fabricate via traditional "top-down" lithography, new "bottom-up" synthesis techniques utilizing molecular self-assembly show great promise for creating flexible, atomically-engineered networks. We have recently made progress at fabricating new graphene nanostructures in this way from chemically engineered precursor molecules. New measurements on these systems will be discussed.