Single Carbon Atom Chains

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Free standing graphene was studied by an objective side Cs-corrected transmission electron microscope operating at 80 kV. Experiments by HRTEM imaging on the single layer graphene show a reliable synthesis of a one dimensional carbon species, single-atom carbon chains. Formation of the monoatomic carbon chains is observed where graphene bridges between two holes in the graphene membrane shrink under electron irradiation [1,2]. The ultra-narrow graphene ribbons show transitional and highly stable structural rearrangements (e.g. Pentaheptite[3]-like pure carbon planar structures) preceding the formation of the carbon chains. Carbon chains also occur between carbonaceous adsorbates on top of the graphene layer and looping along graphene edges. The process of shrinking the graphene ribbon and the formation of single carbon atom chains were observed in real time at atomic resolution. The process of formation of the transitional structures and single carbon atom chains, indicate the feasibility of specific fabrication of carbon nanodevices and further characterization and analysis.

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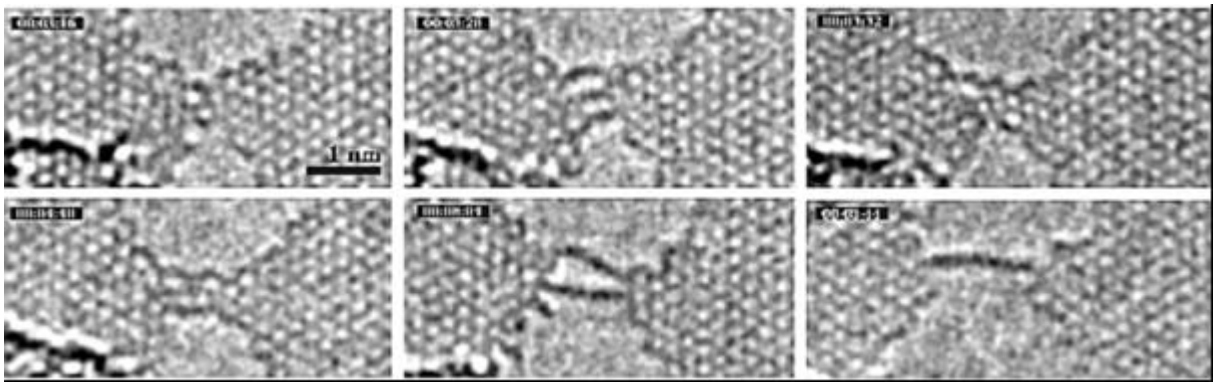

Figure 1. Evolution of a graphene constriction. From a graphene bridge via stable transitional structures to single carbon chains.

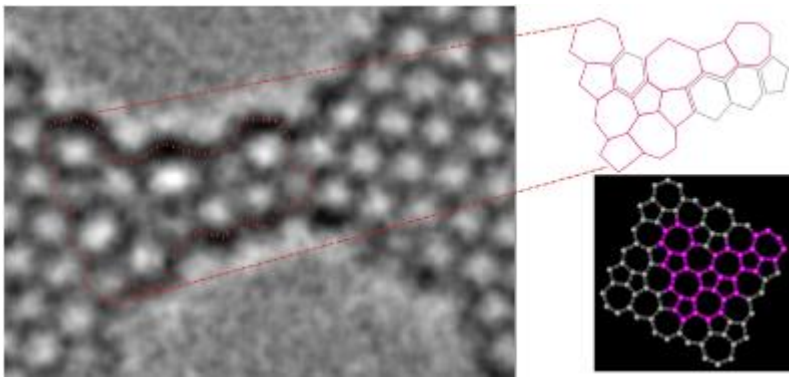

Figure 2. Stable configuration within reconstruction of a graphene bridge. Stable transitional structure formed by pentagon-heptagon pairs (red dotted area). Upper right hand side a geometrical model of the structure and bottom right hand side atomistic model of pentaheptite (in pink the corresponding pentaheptite structure to the observed structure).

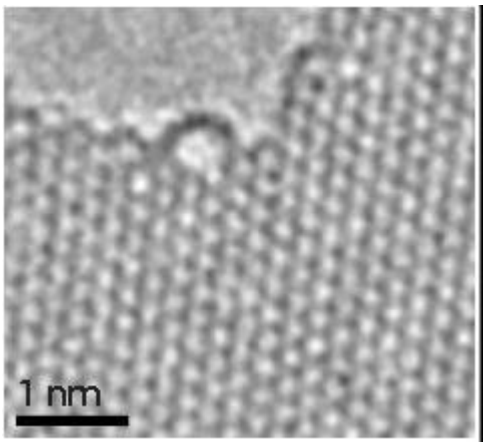

Figure 3. Single carbon chain at graphene edge. A single carbon chain loops between carbon atoms at the edge of the graphene structure.

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