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Abstract Title: **Efficient Manipulation of Zigzag and Armchair Edges in Graphene Nanoribbons by Joule Heating**

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Short Description: *(approximately 100 words)*

Edge study in graphene nanoribbons has attracted lots of interest in recent years, due to the different electronic properties of the ribbons arising from zigzag and armchair edges. Here we demonstrate and monitor an efficient crystallization process for graphite nanoribbon edges by Joule heating inside an integrated transmission electron microscope equipped with a scanning tunneling stage STM (TEM-STM system). During the Joule heating process, the ribbon resistance continuously drops, the graphite layers evaporate and sharp edges and step-edge arrays are formed, most of which show either zigzag or armchair edge configurations. A detailed study of the edge evolution and motion indicate that both temperature and electric field contribute to forming these preferential sharp edges.

Talk Summary:

Here we showed that: (1) Joule annealing can transform highly defective nanoribbon edges into sharp edges and highly crystalline few-layered edge arrays; (2) High temperature causes the (re)structuring of edges toward achiral armchair or zigzag edges; (3) Annealing increases the probability of finding the most stable edge state.

This work demonstrates both the possibility of self-eliminating lattice defects by applying a bias voltage, and an effective way to produce clean zigzag and armchair edges, which could be useful for both fundamental studies of edge reactivity, magnetism and the development of future electronics applications.

List of figures: *(if any)*