Shaping graphene nanoribbons inside an aberration-corrected TEM at low voltages

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Abstract

Graphene nanoribbons (GNR) are predicted to exhibit electronic properties that make them attractive for the fabrication of nanoscale electronic devices. [1] The structural stability of GNR is an important factor which influences its applications. In this study we applied for the first time spherical/chromatic-corrected very-low-voltage high-resolution transmission electron microscopy (AC-HRTEM) [2, 3] to investigate the transformation of GNR inside single-walled carbon nanotube (SWNT) step by step at atomic resolution even at voltages as low as 40 kV. We observe that the 40 kV imaging electrons at the same time trigger the spontaneous formation of nanoribbons out of small ferrocene molecules, which were filled into SWNTs. In the figure we show that the GNR keeps restructuring when being irradiated by 40 kV electron beam while the length of the GNB shortens from 12.34 nm to 7.34 nm. We compare the dynamics of this transformation with our earlier studies triggered by an twice as energetic electron beam of 80 kV [4] and show that size, structure and helical twist can be controlled not only by the width of the host carbon nanotube but also by the energy of the electron beam, which may open up a new road for GNR shaping.

References

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Figures

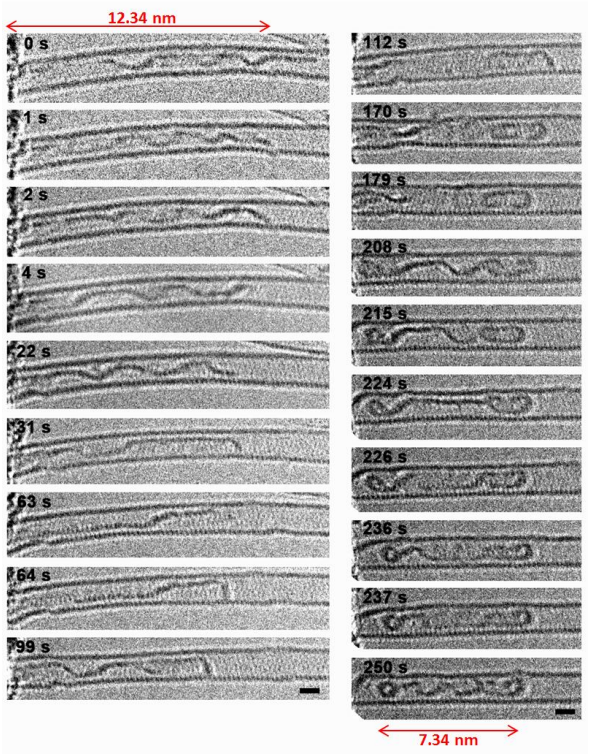

Figure 1: Time-series AC-TEM images showing the transformation of GNB when being irradiated by election beam at 40 kV. The scale bar is 1 nm.