Formation mechanism of carbon atomic chains

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Carbon based nanostructures, such as quasi-one-dimensional carbon nanotubes and two-dimensional graphene, have opened new perspectives towards the carbon-based electronics. Carbon atomic chain is an idea one-dimensional (1D) system, which provide an excellent 1D model for fundamental solid-state research, and have been predicted to be a promising component of atomic-level electronic devices with its astonishing properties, such as unusual electrical transport phenomenon and extremely high stiffness. Transmission electron microscope (TEM) opened up a top-to-down approach to fabricate free-standing atomic carbon wires by sputtering carbon atoms from graphene (from graphene to nanoribbon, and then to atomic chains), and also enabled us to measure the electrical properties of such atomic linear structures. Although substantial progress has been made in recent TEM studies of atom chains, the formation mechanism have not been seriously studied, especially for the kinetic steps of process. For example, what's the driving force of the transformation from nanoribbon to chains?

We studied the atomic formation process of atomic chain by aberration corrected TEM with monochromator. We found that the number of carbon atoms plays a crucial role in thining process from nanoribbon into two atomic chain and the extension of atomic chains. The transformation of ribbon to chain is much more easier when the fromed chains have even number of carbon atoms, which significantly affect the reconstruction of the structure in the contact between atomic chain and graphene. This study may give a deep understanding of the formation mechanism of carbon atomic chains and give a guidance for controllable fabrication of atomic chains.

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