Manipulation of single impurity atoms in 1-, 2-, and 3-dimensional nanostructures using focused electron irradiation

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Recent advances in transmission electron microscopy have made it possible to modify nanostructures with atomic precision. In recent years, progress has been made from occasional observations of Si-C bond inversion in graphene [1] towards controlled movement of Si impurities using the atomically focused electron beam of an aberration-corrected scanning transmission electron microscope [2,3]. We have now demonstrated that the same technique can be used to manipulate Si impurities in single-walled carbon nanotubes (SWCNT) [4]. Recently, it was shown that an electron beam can also be used to controllably position single bismuth dopant atoms in crystalline silicon [5]. Here we summarize our recent experimental results on the manipulation of single atomic impurities in graphene and SWCNTs. We further provide a comprehensive theoretical analysis of the mechanisms and energetics of atomic dynamics in 1-, 2- and 3-dimensional nanostructures obtained using density functional theory m olecular dynamics.

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