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The atomic structure of defects in graphene

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Defects in graphene influence its electronic, magnetic, chemical and mechanical properties. It is therefore important to have a detailed understanding of their exact atomic structure in order to accurately predict their behaviour. In this talk I will present a summary of research on resolving the atomic structure of vacancy defects in graphene, single atom dopants covalently bonded in the lattice, and their transition dynamics. By using aberration-corrected transmission electron microscopy, combined with monochromation of the electron source to reduce chromatic aberration effects, sub-Angstrom spatial resolution at a low accelerating voltage of 80 kV is achieved. Methods have been developed to introduce defects into the lattice of graphene with 10 nm spatial accuracy within the electron microscope using a controlled focussed beam. This enables the study of defect structures with unprecedented clarity and accuracy whilst in a low-pressure vacuum environment. Atomic models determined from TEM imaging are compared with DFT calculated atomic models to gain deeper insights into the C-C bond lengths and the relationship between electronic charge density distribution and bond lengths.

Keywords: graphene, TEM, defects