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Manipulating covalent impurity atoms with a focused electron beam

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Venue: Faculty of Engineering Bldg. 2, Room 232

Abstract:

Covalently bound impurity atoms in crystal lattices can be manipulated using the atomically focused electron probe of an aberration-corrected scanning transmission electron microscope, revealing inspiring new perspectives for top-down atomic engineering [1].

This was first realized for incidental silicon impurities in single-layer graphene. Elastic scattering of a probe electron causes the Si to directly exchange places with one neighboring C atom via an out-of-plane displacement [2], and such dynamics can be controlled by directing the electron beam at the desired atomic site [3,4]. In addition to P and Al in graphene, manipulation of Si was also possible in single-walled carbon nanotubes [5].

Perhaps even more excitingly, the electron-beam manipulation of Bi dopants in bulk silicon has also been shown [6]. Our established ab initio modeling methodology has revealed a novel type of non-destructive mechanism we call indirect exchange. Further, we demonstrate that Sb can likewise be manipulated [7].

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[2] T. Susi et al., Phys. Rev. Lett. 113, 115501 (2014)
[3] T. Susi et al., Ultramicroscopy 180, 163 (2017)
[4] M. Tripathi et al., Nano Lett. 18, 5319 (2018)
[5] K. Mustonen et al., Adv. Func. Mat. 29, 1901327 (2019)
[6] B.M. Hudak et al., ACS Nano 12, 5873–5879 (2018)
[7] A. Markevich et al., J. Phys. Chem. C 125, 16041 (2021)

主催：
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