# Phonon-mediated superconductivity in graphene by lithium deposition

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Nature Physics (2012)

Of all the unique properties of strength, flexibility and intriguing optoelectronic behavior, one phenomenon is notably absent from the repertoire of graphene: superconductivity. If graphene could be a superconductor many new efficiencies of applications would emerge.

Graphene itself is not superconducting, because the density of states of the Dirac bands is very low, their coupling is strong only with ineffective high-energy phonon modes, while their coupling with out-of-plane phonon modes are forbidden by symmetry. So, phonon-mediated superconductivity must be induced by an enhancement of the electron–phonon coupling bringing new electronic states at the Fermi level as happens in GICs.

We discovered that in graphene doped with lithium adatoms, the removal of quantum confinement along the out-of-plane direction, brings the interlayer to the Fermi level, realizing a system without a bulk GIC counterpart.

We found that the interlayer is strongly localized around the adatom and closer to the graphene layer, switching on the electron–phonon coupling of carbon out-of-plane modes that is inactive in the bulk and increasing the contribution of intercalant modes.

Graphene can be made superconducting by the deposition of lithium atoms on top of it, with an estimated superconducting critical temperature of 18 K when lithium atoms are deposited on both sides of the graphene sheet

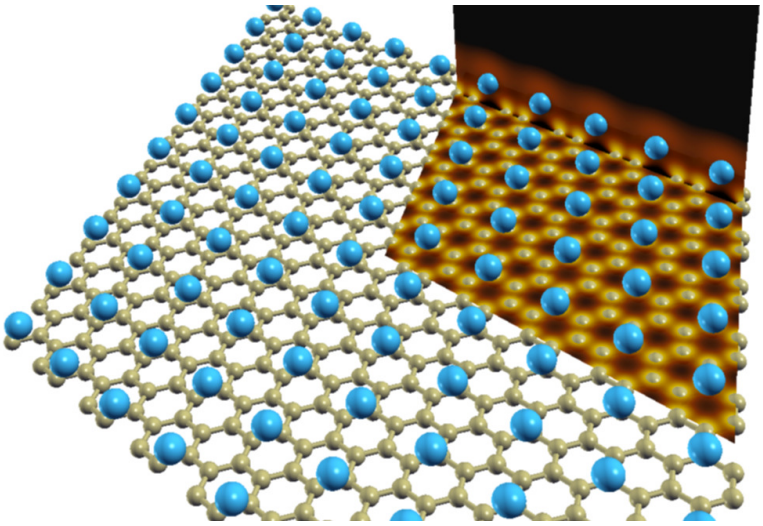

Fig.: Lithium adatoms on graphene and charge density of the interlayer state