MAR11-2010-004323

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Gap control via graphene solid-state reactions

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While a gapless dispersion law of Dirac fermions in graphene does warrant admiration, to serve as useful semiconductor graphene needs a gap. Relatively inert, it can nevertheless be induced to react. A generic outcome of a reaction, C + A -> $C_{1-x}A_x$ is a transition of some C-atoms from their sp^2- into sp^3-state, corresponding to a situation of the insulating, ultimate (mono- or few-layer) diamond slab [1]. Computations support a concept that the product of such reactions (A = H, F, O, Cl, etc.) forms a well-defined phase [2], permitting a patterning of 2D-geometries with useful properties: interconnects-nanoroads [3], quantum isles-dots [4], etc. Comparison of hydrogenation (A = H) into graphAne with fluorination (A = F) into 2D-teflon, shows the former as hindered by nucleation barrier and reversible (H-storage), in contrast to barrier-less reaction into a stable CF in the latter. *** In collaboration with F. Ding, E. Penev, M.A. Ribas, and A.K. Singh. ***

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