2D OR NOT 2D? LAYERED FUNCTIONAL MATERIALS "BEYOND GRAPHENE".

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As of 2015, the number of mobile phone subscriptions outstrips Earth's human population. *Critical raw materials (CRMs) and silicon, won in energy intensive refinement make up the electronics in all these devices. While graphene still has to deliver on its potential in electronic applications, we look to 2D polymer materials that go beyond silicon and graphene.*

Since its recent rise, graphene has been considered as a candidate material for "post-silicon electronics" merit its advantageous combination of high electrical and thermal conductivity and stability. However, the (half-)metallic character of graphene and the resulting absence of an electronic band gap have frustrated the development of a graphene-based electronic switch so far.[1] In a recent publication by Geim *et al.* the lack of non-metallic 2D-matrials for the construction of electronic devices becomes all too apparent.[2] Only five materials of the "graphene family" are known: graphene, hBN, BCN, fluorographene, and graphene oxide. The potential to extend this exclusive club is a great challenge to our academic grasp of chemical bond formation and material design. Organic polymer frameworks, in particular, allow broad control over composition because of the wide range of chemistry that is available. Likewise, they afford chemical and thermal stability due to their strong, covalent backbone.

In this contribution, we present functional, ordered, two-dimensional organic materials and their underlying design-principles on the example of covalently-linked, triazine (C_3N_3) and heptazine (C_6N_7) based, layered materials.[3-5] The resulting materials yield networks with high surface areas (SA_{BET} exceeding 3000 $m^2\ g^{-1}$ in some cases), and an optical band gap, but more intriguingly also allow the construction of frameworks with long-range, two-dimensional order.

References:

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