On the Quest for Rhombohedral Stacking in Graphene

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The year 2018 was a breakthrough moment in the graphene community. The experiments on twisted bilayer structures, performed at MIT, showed the occurrence of the "magic" relative angles between layers, for which correlated behavior and unconventional superconductivity were observed [1]. The discovery motivated the scientific community to revise low-dimensional structures with similar electronic structures, i.e., flat bands at the Fermi level, again. These are characteristic, for example, for few-layer graphene with rhombohedral stacking. Theoretical and experimental works report on interesting phenomena hosted by these structures. Rhombohedral graphene appears to reveal tunable conducting surface states [2], is expected to exhibit spontaneous QHE [3] and even surface superconductivity [4]. What is more, it appears to be a topological material [5].
The difficulty in exploring rhombohedral graphene is that in experiments, the alternative stacking, hexagonal (Bernal) one is the most common geometry [6]. For many years, this form of graphene was considered the most stable. Recent studies [7], however, encourage to reexamine this subject again. We perform detailed research on the relative stability of trilayer graphene stackings and show how delicate this issue is. Few-layer graphene appears to possess two basic stackings with similar formation energy, which can be accessed by selective synthesis approaches. We find different types of anisotropic strain that induce the transition from rhombohedral to Bernal stacking. In our research, we seek a guide on how to control – either preserve or change the stackings in multilayer graphene samples.

References

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Figures

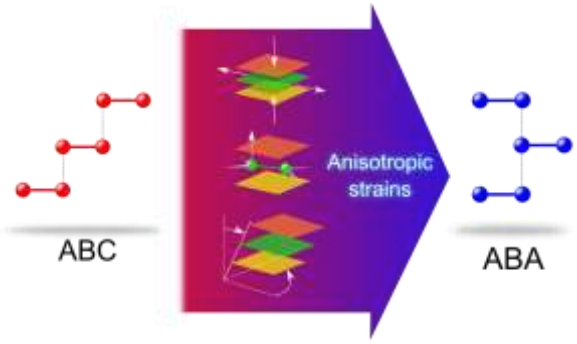

Figure 1: Different types of anisotropic strains that induce transition from rhombohedral (ABC) to Bernal (ABA) stacking.