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Graphene formation on 3C-SiC ultrathin film on Si substrates

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Since the discovery of graphene by mechanical exfoliation from graphite[1], various fabrication methods are available today such as chemical exfoliation, epitaxial graphene on SiC substrates, etc. In view of industrialization, the mechanical exfoliation method may not be an option. Epitaxial graphene on SiC substrates, in this respect, is by far more practical because the method consists of conventional thermal treatments familiar to semiconductor industry. Still, the use of the SiC substrate itself, and hence the incompatibility with the Si technology, lessens the importance of this technology in its future industrialization.

In this context, we have tackled the problem of forming graphene on Si substrates (GOS). Our strategy is to form an ultrathin (~80 nm) SiC layer on top of a Si substrate, and to graphitize the top SiC layers by a vacuum annealing. We have actually succeeded in forming the GOS structure [2,3,4]. Raman-scattering microscopy indicates presence of few-layer graphene (FLG) formed on our annealed SiC/Si heterostructure, with the G (1580 cm^{-1}) and the G'(2700 cm^{-1}) bands, both related to ideal graphene, clearly observed. Presence of the D (1350 cm^{-1}) band indicates presence of defects in our GOS films, whose elimination remains as a challenge in the future.

To obtain qualified graphene films on Si substrate, formation of qualified SiC films is crucial in the first place, and is achieved by tuning the growth parameters into a process window[5]. With a potential for forming graphene films on large-scale Si wafers, GOS is a powerful candidate as a key technology in bringing graphene into silicon technology.

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