Contribution ID : **46** Type : **not specified**

The endless possibilities of graphene on heteroepitaxial silicon carbide

Thursday, 4 February 2016 08:45 (30)

Epitaxial graphene grown using solid source carbon from silicon carbide wafers has been for long time the only route to obtain high quality graphene directly grown at the wafer –level, which is crucial to realise the promise of graphene for nanodevices. Nonetheless, the capability of obtaining comparable quality of graphene on silicon as opposed to silicon carbide wafers, would open an immense opportunity for graphene in integrated circuits and micro-systems in general. While encouraging results have been obtained through thermal decomposition of heteroepitaxial SiC films on silicon wafers, this has usually been limited to small areas and to the use of Si (111) surfaces. Moreover, the obtained graphene quality tends to be strongly hampered by the upper limitation in synthesis temperature set by the melting temperature of silicon.
We have recently demonstrated for the first time that most of those limitations can be overcome with the use of heteroepitaxial silicon carbide films in combination with a catalytic alloy of nickel and copper. With this approach we obtain 2 layers graphene on silicon carbide with uniform coverage over the silicon wafer and an average ID/IG ratio of about 0.2 +/- 0.05 [1], indicating a substantial improvement as compared to a ratio of ~1 and above of graphene through the more conventional thermal decomposition. This novel catalytic approach on silicon holds high promise for integrated applications also through the capability for straightforward graphene micropatterning through self-aligned synthesis on pre-structured silicon carbide on silicon [2]. Moreover, we have demonstrated the potential for this approach to fabricate high –performing electrodes for integrated supercapacitor structures [3].
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Session Classification : Invited talk