Graphene for Beyond CMOS Devices

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Electronic devices fabricated on silicon, III-V, and II-VI compounds require the highest quality material that can be achieved in order to meet the performance, uniformity, reliability, and cost requirements. The semiconductor industry has demonstrated the ability to produce and provide high quality and reliable devices to the community for many decades as a result of its ability to produce and integrate the highest quality materials. As we move toward trying to replace the basic electronic device, the transistor, with new materials whether it is using Ge, III-Vs or graphene, the highest quality material will be needed to continue meeting the stringent requirements.

Graphene is being studied as a new switch material for devices beyond CMOS. Assuming that the material has the necessary fundamental properties required to fabricate the new switch, namely a Bose-Einstein condensate (BEC), it is will be necessary to grow large area films with the highest quality in order to fabricate these new devices in a manufacturing environment. Graphene will have to be integrated with dielectrics and metals to fabricate the simplest device structures and thus it may be necessary to grow this material defect free. Graphene can be produced by several techniques: 1) exfoliation from bulk graphite[1-3]; 2) chemical reduction of exfoliated graphite oxide[4]; 3) precipitation from bulk metals[5-7]; 4) growth on SiC by silicon desorption[8,9]; and 5) chemical vapor deposition on copper surface[10] or metal surfaces with extremely C solubility of C diffusivity. Growth on very low carbon solubility substrates like copper occurs by a surface mediated process and can cover extremely large areas. Recently Li et al.[11] have also discovered that large single crystals can be grown without domains or grain. The objective of this presentation is to describe the growth process of graphene on metals and how we can use this process to create high quality large area graphene. Figure 1 shows an SEM image of a single graphene domain that according to LEEM (Li et al) is single crystal across the entire domain (400 to 500 □m)[11].

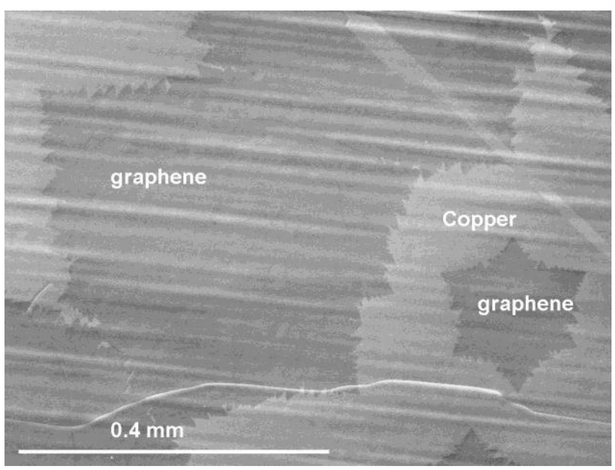

Figure 1. Large single crystals of graphene grown by low pressure chemical vapor deposition. LEEM analysis has shown that these crystals are mostly single crystals. (Li et al.).

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