Graphene Synthesis by Carbon Ion Implantation in Transition Metals Films

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Graphene, the first known and stable 2D crystal, was isolated in 2004. Since then, this new nanomaterial is the object of a large interest, due to its intriguing properties as well as to the range of its possible applications. From fundamental quantum and transport phenomena, to spintronics and to more applied research fields such as displays, large area electronics and photovoltaics, graphene has attracted a large community of physicists, material scientists and chemists. However, bringing graphene out of research laboratories will require a reliable, low cost and easily scalable synthesis process. Although micromechanical exfoliation of graphite was the first technique used to isolate graphene, it is not enough reproducible and not amenable to large areas. Other early routes for the synthesis of graphene are the epitaxial growth on silicon carbide or on monocrystalline transition metals such as ruthenium, platinium or iridium. More recently, the chemical exfoliation of graphite or the CVD-based growth have yielded interesting results, compatible with large areas.

In this work, we will present a novel graphene synthesis technique, based on the ion implantation of carbon ions into polycrystalline transition metal thin films. Ion implantation is now a routine process developed by the semiconductor industry over the past three decades. It is used to dope the source and drain contact regions as well as to adjust the channel characteristics of CMOS transistors. One of the advantages of ion implantation is that it allows one to precisely control the carbon dose introduced in a particular substrate. This can be exploited to understand the growth mechanism of graphene on transition metals but also to control the number of graphene layers (one, two or more) by precisely introducing the corresponding numbers of carbon atoms into the metal catalyst support, having in mind that one graphene layer corresponds to ~ 3.8×10^{15} carbon atoms/cm^2.

Some results will be presented concerning the synthesis of graphene on nickel, gold and copper thin films.

978-1-4244-6644-3/10/$26.00 ©2010 IEEE