Extended Abstract

Graphene 2018: Graphene on Diamond-James C Sung-Synthetic Element Six (SES)

Abstract

Graphene is the stretched diamond plane graphene can be formed martensitic alloy without breaking the carbon bonds, on diamond surface by specialty heat treatment in vacuum. In this case, Graphene on Diamond (GOD) heteroepitaxy is similar to homo-epitaxy so the signal transmission is continuous. GOD is an ideal computational device as graphene contains the most effective transmission lattice, capable of terahertz communication by Mach 100 speed of phonon (lattice vibration). On the other hand, diamond is considered to be the most stable quantum computing solid due to its highest Debye temperature. During the quantum computing, the Q-bits must be entangled without atomic vibration, and diamond's super hard lattice is capable to maintain this stability for milliseconds, even at room temperature. Diamond contains about 1% C13 isotope atoms in the lattice. These atoms may be ion planted and heat treated to cluster as Q-bits. The superposition of spins from the extra neutron in the nuclei would be the best mechanism for Quantum computing. With about 50 Q-bits entangled in milliseconds while these Q-bits are stationary, the vast Computational possibilities can tackle even more difficult problems that for all human transistors combined. With GOD, the quantum computing can be initiated with graphene on cubical face (100) of diamond; and the Collapsed quantum waves may exit from octahedral face (111). Thus, GOD would be the dream AI chip that Outperforms even the smartest combinations of all current computers interconnected together.

The formation of high-quality graphene layers on diamond was gained based on a high-temerature annealing technique using a Cu catalyst. Common features of monolayer graphene were observed in the Raman spectra of layers formed by annealing of Cu/diamond heterostructures at 950 °C for 90 min. The coverage ratio of these graphene layers on diamond used to be estimated to be on the order of 85% through Raman mapping of the 2D peak. The sheet gap concentration and mobility values of the layers have been estimated to be ~ 1013 cm− 2 and ~ 670 cm2/Vs, respectively. These values are similar to those in the past observed for High quality graphene layers on SiC.

The process within reach is proposed for engineering the electronic properties (including the band structure) of diamond along surface hybridization with graphene. Graphene layers (5–50 nm in thickness) were grown vertically onto a polished textured polycrystalline diamond plate (1 × 1 cm2) (vGr-diamond) at ~1300 °C along hydrogen plasma etching in a chemical vapor deposition (CVD) chamber. Due to the crystallographic relationship, the graphene layers embed at an angle of 30° to the diamond surface comprising the planes.

The epitaxial relationship is validated by low angle X-ray diffraction (XRD), the XRD rocking curve, Raman and scanning electron microscopy. With hybridization, the diamond pattern exhibits a sturdy photoluminescent (PL) sign at ∼2.78 eV (∼450 nm). The top was assigned to the ‘interface defects’ of the VGr-diamond hybrid structure, which are a kind of ‘surface defect’ of the CVD diamond that generates a top at ∼2.69 eV. The blue shift (∼90 meV) of the interface defects is due to the compressive stress of ∼3% applied to the interface atoms. Simulations indicate that the hybrid structures possess a finite band gap of 1.85–0.25 eV, which decreases upon growing the thickness of the graphene layers to ∼1.4 nm. The appearance of a small band hole used to be attributed to the compressive strain. These findings may also furnish a route for diamond to become a platform for subsequent generation and intense electronic devices.

The exploration of diamond electronics,1,2 launched with the successful synthesis of diamond by means of chemical vapor deposition (CVD)3,4 in the 1980s, is nevertheless challenging. This is due to not only the trouble of the deposition location (∼1 × 1 cm2) for single crystal diamond plates,4,5 however also to the subject in band gap engineering.6,7 Doping an impurity is an best way to band gap engineer a semiconducting fabric and this has opened up the use of silicon in the modern-day era. For diamond with a wide band gap of 5.47 eV, however, the doping approach revealed difficulty in controlling the dopants as properly as degradation of crystallinity with heavy doping of boron or nitrogen.6 The latter problem is more radical because it is due to a trade of gas chemistry at some stage in the in situ doping. With the current progress on synthesis of 2D substances inclusive of graphene, structural hybridization has been advised as a viable way to use band gap engineering for novel materials.10–14 .For instance, the lateral hetero shape of hexagonal boron nitride (h-BN) (insulating) with graphene (semi-metallic) tunes the band gap of h-BN or graphene.

The researchers observed that two layers of graphene stacked on top of one another can briefly turn out to be as hard as diamond and just as impenetrable ,for instance when it struck a bullet and the hardening material is called as diamene. Polycrystalline diamond compact (PDC) cutters are used widely for mining and drilling in gentle to medium difficult rock formations. During drilling in incredibly challenging and robust rock formations, the speedy put on of the polycrystalline diamond layer effects in a low provider existence of drilling bits. To enhance the overall performance of PDC cutters, it is adopted a high-temperature, high-pressure (HTHP) sintering technique (5.5–6.0 GPa and 1350–1500 °C) in the modern-day research by using adding a certain quantity of graphene to raw materials, and it is efficiently organized a new kind of high-performance diamond composite PDC-G (graphene used to be brought to PDC).The investigation on the microstructure, residual stress, hardness, wear resistance, thermal conductivity, and electrical conductivity of the as-synthesized PDC-G is done . Compared with PDC besides graphene, the hardness and put on resistance of PDC-G with 0.1 wt% graphene addition had been more advantageous by 75% and 33%, respectively. Moreover, the electrical conductivity of PDC prepared by graphene strengthening was once increased 42-fold. The strengthening mechanism of PDC-G by and large befell as a result of the lubricating effect of graphene between diamond particles.

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