

## Raman Spectroscopy of CVD Graphene during the Transfer Process from Copper to SiO<sub>2</sub>/Si Substrates

Claudia Bautista-Flores

*Tecnológico de Monterrey, Mexico*

The Raman range of CVD graphene was observed amid the exchange preparation, from the developing copper substrate to the ultimate silicon substrate, passing through diverse fluids utilized to break down copper and to clean the coming about carbon film. The position of G and 2D crests moved when graphene was on the surface of distinctive fluids. The biggest Raman move happened for ferric nitrate and nitric corrosive arrangements; this result appears to show that these arrangements actuated the p-type character of CVD graphene. The basic finding is that the circumstance of graphene (strain and doping) stored by means of a CVD strategy changes when it is interpreted from the first to the ultimate substrate.

We arranged single-layer graphene movies through mechanical shedding of Kish graphite and chemical vapor testimony methods. These tests were treated in nitric corrosive, sulfuric corrosive, sodium hydroxide and ammonium hydroxide arrangements to initiate doping. We utilized smaller scale Raman Spectroscopy some time recently and after the chemical functionalization to screen contrasts within the Raman range. We found moving for both G and 2D crests of graphene and a noteworthy upshifting in tests treated with sulfuric corrosive, comparable to those detailed for nitric corrosive.

In this work we ponder sulfur restricted between two multilayer graphene movies beneath warm medicines by means of electrical and Raman spectroscopy characterization. We found a few similarities between the electrical behavior and differential filtering calorimetry of sulfur drenched into nanoporous anodic alumina format amid sulfur stage moves, this proposes that sulfur includes a distinctive warm behavior when it is in keeping conditions compared to the free state. In expansion, multilayer graphene was uncovered to sulfur vapors at 500 [deg]C to actuate chemical response. This strategy successfully created covalent holding between sulfur and multilayer graphene and a p-type doping of almost  $2 \times 10^{13} \text{ cm}^{-2}$  in charge concentration. At last, based on to begin with rule calculations we guess on the presence of a modern bidimensional structure of sulfur.

Graphene as a zero band crevice semiconductor isn't able to be joined into electronic gadgets as other semiconductors do, such as silicon or gallium arsenide. A part of exertion has been contributed to open a band hole in graphene or to move its Fermi level. Doping is an elective way to tailor electronic properties of graphene. Doping in graphene can be initiated by substrate, by substitution with other particles such as nitrogen or boron, applying an electric field, or by retaining particles or molecules on the graphene surface. For the final case, nitric corrosive (HNO<sub>3</sub>) has served to get p-type graphene and smelling salts was utilized to create n-type graphene through electrothermal responses. Moreover, when a lean film of fullerene C60 is stored on a few layer graphene the coming about framework appears to have negative photoconductivity and both p- and n-type doping depending on the concentration of illumination.

Since graphene can effectively adsorb atoms on its surface, we utilize a few arrangements to look for a comparable or superior doping

substance than HNO<sub>3</sub>. Nitric and sulfuric acids are commonly utilized for the enactment of an assortment of carbonaceous materials and, on the other side, the appearance of a ferromagnetic behavior of graphite by sulfuric corrosive (H<sub>2</sub>SO<sub>4</sub>) medications has been detailed. One of the most discoveries of the show work is that by the utilization of a straightforward strategy, H<sub>2</sub>SO<sub>4</sub> produces a proficient doping in graphene. To our knowledge, usually the primary time that such impact is detailed. For the consideration of doping in graphene, Raman spectroscopy has come about to be a reasonable nondestructive and effective quantitative strategy. For n-type graphene, utilizing adsorption of particles with electron giving bunches, G band downshifts. In p sort doped graphene utilizing adsorption of atoms with electron pulling back bunches, G band upshifts. In both cases, 2D band upshifts.

For comparison purposes, two sorts of graphene tests were utilized within the show work: tests of graphene obtained by mechanical shedding of Kish graphite utilizing cement tape and by chemical vapor testimony strategy (CVD). For CVD graphene tests, copper thwart pieces of 1 cm × 2 cm were utilized as substrates, and a blend of hydrogen and methane as the carbon source was utilized at surrounding weight and 1000°C. After CVD amalgamation, one side of the test was spin-coated with PMMA (46 mg/ml) and strengthened in a heater at 160°C for 5 minutes to unwind the PMMA film. Copper was expelled with a ferric nitrate arrangement and after that PMMA/graphene film was put on beat of a silicon substrate with 306 nm of silicon oxide. At last, PMMA was carved with acetone. The tests were immersed during a period of time of 24 hours in numerous watery arrangements: nitric corrosive (HNO<sub>3</sub> at 65.9%), sulfuric corrosive (H<sub>2</sub>SO<sub>4</sub> at 65.9%), sodium hydroxide (NaOH at 2 M) and ammonium hydroxide (NH<sub>4</sub>OH at 29%). After this treatment, the tests were washed for a few seconds in deionized water to dispense with the overabundance of the chemicals. The graphene layers were pre-identified utilizing optical differentiate and after that authenticated

utilizing Raman spectroscopy. For Raman characterization a Nicolet Almega XR Spectrometer and 532 nm laser excitation was utilized, to dodge warm impacts we fairly utilized 2 mW of laser power. Raman spectra were taken within the flawless state and after chemical functionalization on the same test, being the detailed numerical comes about and normally taken on distinctive samples.

Raman spectra of a few exfoliated graphene tests have appeared. It can be watched that Pos(G) and Pos(2D) move when graphene is functionalized. Since both G and 2D crests upshift when HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> and NaOH are utilized, we will say that these arrangements create

p-type graphene. The foremost critical moving is accomplished with HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>, authenticating the good performance of nitric corrosive as a doping specialist as has been detailed within the writing. Doping utilizing NaOH and NH<sub>4</sub>OH has not been detailed however. We moreover see the normal of Pos(G) for each case and their comparing Fermi vitality (EF) and carrier concentration (n) calculated