NS-001 **<Invited Speaker>**

Development of a Photoemission-assisted Plasma-enhanced CVD Process and Its Application to Synthesis of Carbon Thin Films: Diamond, Graphite, Graphene and Diamond-like Carbon

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We have developed a photoemission-assisted plasma-enhanced chemical vapor deposition (PAPE-CVD) [1,2], in which photoelectrons emitting from the substrate surface irradiated with UV light ($h\nu$ =7.2 eV) from a Xe excimer lamp are utilized as a trigger for generating DC discharge plasma as depicted in Fig. 1. As a result, photoemission-assisted plasma can appear just above the substrate surface with a limited interval between the substrate and the electrode (～10 mm), enabling us to suppress effectively the unintended deposition of soot on the chamber walls, to increase the deposition rate, and to decrease drastically the electric power consumption. In case of the deposition of DLC gate insulator films for the top-gate graphene channel FET, plasma discharge power is reduced down to as low as 0.01W, giving rise to decrease significantly the plasma-induced damage on the graphene channel [3]. In addition, DLC thickness can be precisely controlled in an atomic scale and dielectric constant is also changed from low κ for the passivation layer to high κ for the gate insulator. On the other hand, negative electron affinity (NEA) of a hydrogen-terminated diamond surface is attractive and of practical importance for PAPECVD, because the diamond surface under PAPE-CVD with H2-diluted (about 1%) CH4 gas is exposed to a lot of hydrogen radicals and therefore can perform as a high-efficiency electron emitter due to NEA. In fact, we observed a large change of discharge current between with and without hydrogen termination. It is noted that photoelectrons are emitted from the SiO2 (350 nm)/Si interface with 7.2-eV UV light, making it possible to grow few-layer graphene on the thick SiO2 surface with no transition layer of amorphous carbon by means of PAPE-CVD without any metal catalyst.

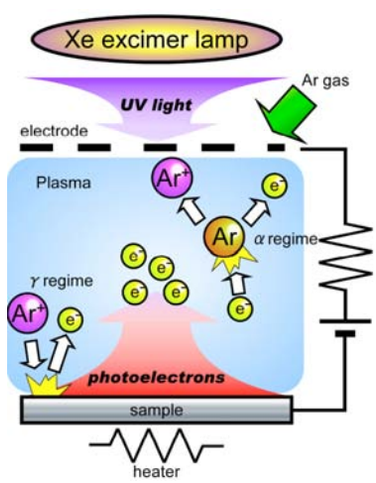

Fig. 1. Schematic illustration of theprinciple of PAPE-CVD with Ar gas.

References

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