Suspended Graphene Nanoribbons for Non-Volatil Optical Memory Operation

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Graphene nanoribbons (GNRs) combine the unique electronic and spin properties of graphene with a transport gap that arises from quantum confinement and edge effects. This makes them an attractive candidate material for the channels of next-generation transistors. Up to now, we developed a novel method based on the advanced plasma CVD method with nano scale Ni catalyst (Ni nanobar) for directly fabricating suspended GNRs devices [1]. However, the growth yield of suspended GNRs is low and understanding the growth mechanism is required to solve this problem. Based on this background, we attempted to elucidate the growth dynamics of GNRs in our method by the comparison of molecular dynamics simulation and phase diagram calculation with the systematically obtained experimental results. By following this growth model, the yield of suspended GNR growth can be drastically improved (~98%) and wafer-scale synthesis of 1,000,000 suspended GNRs has been realized [2].

Furthermore, we measured photoresponse of current in GNRs array under the field effect transistor (FET) configurations. It is found the current of GNR can be drastically changed by photo irradiation and the current change can be maintained for a long time even after stopping the photo irradiation, which is known as a persistent photoconductivity (PPC). This phenomenon can be understood due to hot carrier trapping in some trapping sites, which is same as a kind of operation principal of non-volatile optical memory, indicating the wafer-scale GNR array grown by our method can be useful as a novel optical-memory device.

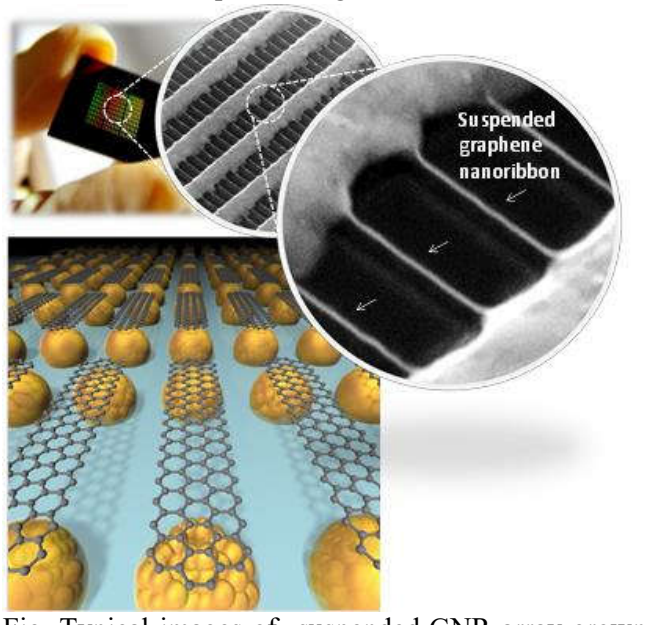

Fig. Typical images of suspended-GNR array grown by our method.

References:

[1] T. Kato and R. Hatakeyama, Nat. Nanotechnol. **7**, 651 (2012).

[2] H. Suzuki, T. Kaneko, Y. Shibuta, M. Ohno, Y. Maekawa, and T. Kato, Nat. Commun. **7**, 11797 (2016).

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