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Photo-reduction of graphene oxide (GO) by femtosecond laser irradiation

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As reported by Geim and Novoselov et al. [(1)] in 2004, graphene has attracted much interest in scientific field due to its superior properties such as excellent mechanical strength, high thermal conductivity, fast electronic carrier and optical properties, originated from the unique conjugated conformation and band structure. In addition, many prospected applications are proposed either in pure form or in combination with other materials [(2)].

Although several methods have been developed for graphene formation, one of the effective approaches is to use a reduction process of graphene oxide (GO), which is alkyl-, acetyl- and/or carbonyl-modified graphene and is dispersed in water without any stabilizers. Among several approaches for reduction of GO (formation of rGO), photo-induced reduction method is promising because it is an easy, inexpensive, eco-friendly process [(3)]. However, detailed formation mechanism of rGO through photo-induced reduction remains unclear. In this study, pure photo-induced reduction of GO was studied by using femtosecond laser irradiation without taking any thermal effect into account. 10 wt% of GO solution was kept in a 3 mL quartz glass cuvette and stirred by a magnetic stirrer. Femtosecond laser pulse (λ: 800 nm, pulse width: 100fs, rep. rate: 100 Hz) was introduced into the normal cuvette without focusing. The laser energy and total number of pulses were controlled to investigate the effect of irradiation on the formation of rGO. Characterizations of rGO were performed by UV-vis photo-absorption spectroscopy, Raman spectroscopy, XPS, FT-IR. After a certain time of irradiation, the color of solution was changed from transparent brown to black, and the black colored colloid became precipitated on the bottom of cuvette without stirring. Based on the UV-Vis spectra, longer irradiation of the GO solution resulted in the change of the oxygen content in rGO. After 100 minutes irradiation with laser energy of 5.0 mJ, the oxygen content of rGO was reduced to 30% from 50 % of GO by the pure photo-induced process. Detailed structural information of rGO by the femtosecond laser irradiation will be shown in the presentation.

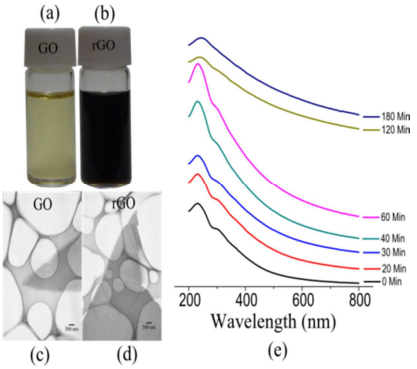

Fig 1. Photographs of (a) GO and (b) rGO solutions before and after femtosecond laser irradiation, respectively. TEM images of (c) GO and (d) rGO. UV-Vis spectra of GO and rGO for different irradiation times (e).

1. *K.S Novoselov, A.K Geim, S.V Morozov, D Jiang, Y Zhang, S.V Dubonos,* et al. *Science, 306, 666-9,(* 2004).

2. *N. Morimoto, S-I. Yamamoto, Y. Takeuchi, Y. Nishina.* RSC Advances, *3, 15608-15612, (*2013).

3. *L.J Cote, R.C. Silva, J. Huang, J. AMCHEM. SOC, 131, 11027-11027, (2009).*