Carbon-heteroatom bond formation and polymerization by ultrasonic spray chemistry

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Abstract

The direct formation of carbon-heteroatom bonds, while essential in chemical/biological processes and energy storage systems, remains technologically challenging[1,2]. On the other hand, conjugated microporous polymers (CMP) are a unique class of 2-dimensional polymers that combine extended p-conjugation with inherent porosity[3]. However, these polymers are synthesized through solution-phase reactions, which preclude not only the evaluation of their conducting properties but also the fabrication of thin films for device implementation[4,5]. Here, we describe a simple and ultrafast method to form carbon-heteroatom bonds in reduced graphene oxide (RGO) by ultrasonic chemical reaction (Figure 1). Furthermore, we also successfully confirmed that the thin film polymerization of CMP by ultrasonic spray technique (Figure 2). These functionalized graphene and CMP materials have shown promising electrochemical energy storage and catalytic properties. Because of the simplicity of the process and the controllability of structural parameters, this approach opens many opportunities in the design and fabrication of electrochemical energy storage devices, as well as other energy-related applications.

References

[1] D. E. Canfield, A. N. Glazer, P. G. Falkowski, Science, 330 (2010) 192-196
[2] E. M. Lodwig et al., Nature 422 (2003) 722-726
[3] A. G. Slater, A. I. Cooper, Science 348 (2015) 988
[4] G. Cheng, B. Bonillo, R. S. Sprick, D. J. Adams, T. Hasell, A. I. Cooper, Adv. Funct. Mater. 24 (2014) 5219–5224.
[5] X. Zhu et al, J. Am. Chem. Soc. 134 (2012) 10478–10484.

Figures

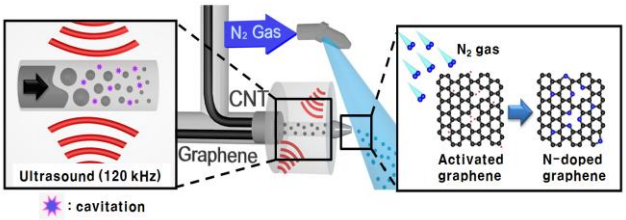

Figure 1: Schematic illustration of the proposed mechanism of heteroatom fixation into graphene by ultrasonic spray.

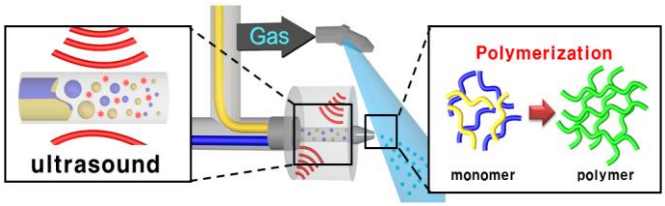

Figure 2: Schematic illustration of the thin film polymerization of 2D conjugated microporous polymer (CMP) by ultrasonic spray deposition .