Controllable fabrication of reduced graphene oxide membranes

H-. H. Huang[1], R. Joshi[2], K. De Silva[1], M. Yoshimura[1]

[1]Graduate School of Engineering, Toyota Technological Institute, Nagoya, 468-8511, Japan
[2]School of Materials Science and Engineering, University of New South Wales, Sydney, NSW, 2052, Australia
h.h.huang@toyota-ti.ac.jp

Membranes with excellent nano-size pores or interlayer channels are of interests for separation processes such as water purification, water desalination, gas separation, and ion sieving [1,2]. Reduced graphene oxide (RGO), two-dimensional sheet with properties resembled to graphene, is an ideal candidate for water desalination due to the high surface area and small interlayer spacing. However, to fabricate uniform RGO membranes is challenging as they tend to agglomerate, aggregate and crumple due to the reduced amount of hydrated functional groups. Here, we investigate the key factor which governs the membrane formation and the mechanisms behind by hydrothermal reduction. GO samples are reduced at 160^{o}C for 30 mins up to 10 h. The surface morphology of the uniform and nonuniform membranes are shown in Fig. 1a,b. When GO is treated at 160 ^{o}C for 1 h, a flat and exfoliated RGO flake with thickness of 0.35 nm (between 1st and 2nd layer) is obtained. This is due to the presence of abundance hydroxyl groups which stabilizes the sheets by hydrogen bonding (Fig. 1c). On the other hand, with the increase in reduction time to 8 h, the RGO sheets tend to agglomerate up to 130 nm in height (Fig. 1b) due to the loss of hydrated functionalities (as schematically illustrated in Fig. 1d). The results show that the surface morphology of the sample is one of the factors which determines the ability to form intact membranes. The mechanism of membrane formation is further discussed.

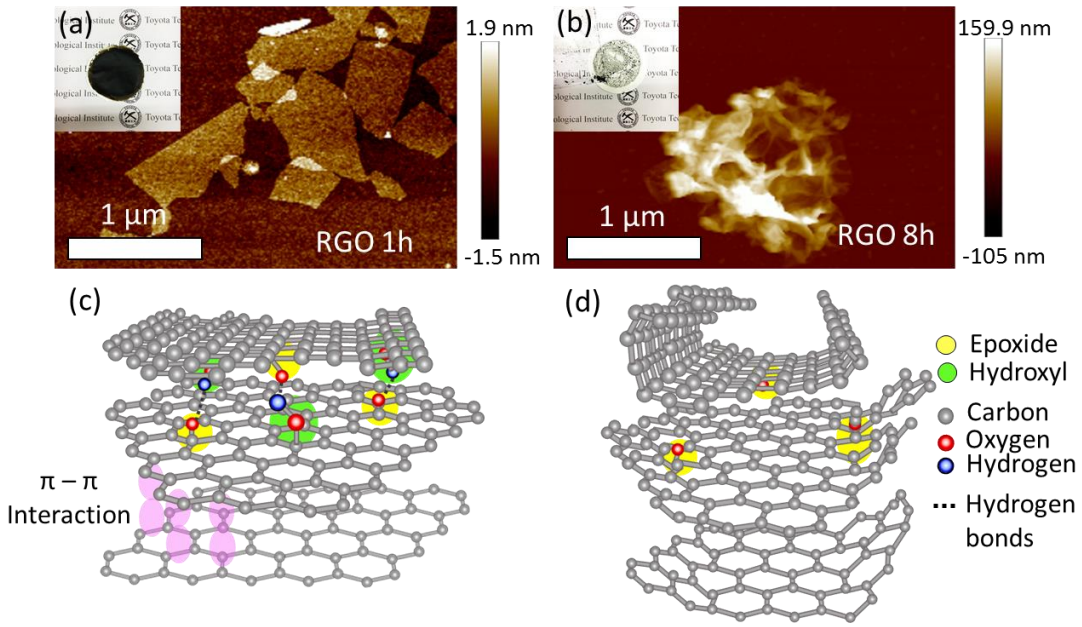

Figure 1 AFM images of (a) RGO treated for 1 h and (b) 8 h. (c) and (d) are the corresponding schematics showing the configuration of RGO membrane.

References:

[1] R. R. Nair, H. A. Wu, P. N. Jayaram, I. V. Grigorieva, A. K. Geim, Science **335**, 442 (2012).
[2] R. K. Joshi, P. Carbone, F. C. Wang, V. G. Kravets, Y. Su, I. V. Grigorieva, H. A. Wu, A. K. Geim, R. R. Nair, Science **343**, 752 (2014).