Correlation of chemical state and adhesion force to nanotribological properties of graphene oxide

Kyoto Univ. ○Kunhua Yu, Yudi Tu, Toru Utsunomiya,

Takashi Ichii, Hiroyuki Sugimura

E-mail: yu.kunhua.83m@st.kyoto-u.ac.jp

Recently, the tribological properties of graphene oxide (GO) has been widely investigated as it can be used as a solid lubricant on solid substrate at micro/ nano-scales. [1] In this study, GO was dispersed on the hydrogen terminated silicon substrate (H-Si) and was reduced by using vacuum-ultraviolet (VUV) light irradiation. Contact-mode atomic force microscopy (AFM) measurements showed that the friction force of the reduced graphene oxide (rGO) regions was smaller than that of the GO regions at various load force condition (as shown in Figure 1a). The difference of surface chemical states between rGO and GO could lead to the difference of friction properties as revealed by X-ray photoelectron spectroscopy (XPS) analyses (as shown in Figure 1b and 1c). [2] The relationship between adhesion force and friction force of rGO/GO pattern was studied by combining the adhesion force image (as shown in Figure 2a) with the lateral force mapping image (as shown in Figure 2b). The experimental results showed that, the region of rGO with smaller adhesion force corresponded to less friction force, indicating that the less interaction between the tip and surface. It is noted that the residual solvent layer on substrate surface also played an important role on nano-tribological properties, which will be discussed at the conference.

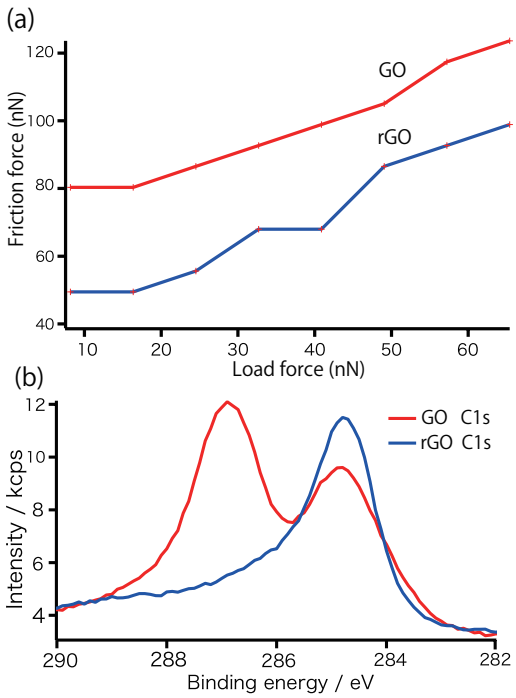

Figure 1 (a) was friction force of GO and rGO surface at various load force. (b) was XPS C1s spectra of GO and rGO.

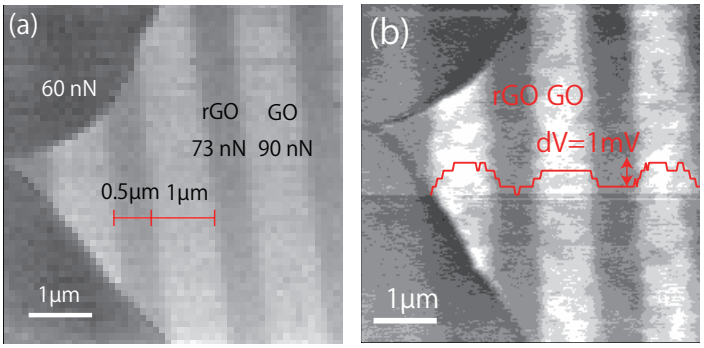

Figure 2 (a) was the adhesion force mapping of rGO/GO pattern. (b) was the lateral force images in trace direction of GO/rGO pattern on H-Si substrate. The brighter region shows larger adhesion force and friction force.

References

[1] Harshal P. Mungse, Yudi Tu, Takashi Ichii, Toru Utsunomiya, Hiroyuki Sugimura and Om P. Khatri, Adv. Mater. Interface **3**, 1500410 (2016).

[2] Yudi Tu, Hiroshi Nakamoto, Takashi Ichii, Toru Utsunomiya, Om Prakash Khatri and Hiroyuki Sugimura, Carbon **119**, 82-90 (2017).