Yusuke Hara[1]
Koushi Yoshihara[2], Kazuki Kondo[2], Shuhei Ogata[2], Takeshi Watanabe[1], Ayumi Ishii[2], Miki Hasegawa[2], and Shinji Koh[1]
[1]Department of Electrical Engineering and Electronics
[2]Department of Chemistry and Biological Science
College of Science and Engineering, Aoyama Gakuin University,
5-10-1 Fuchinobe, Chuo-ku, Sagamihara, Kanagawa 252-5258, Japan.
koh@ee.aoyama.ac.jp

Synthesis of luminescent graphene by adsorption of an amphiphilic Eu complex

Synthesis of luminescent graphene is an intriguing process that will open new possibilities for making ultrathin and flexible light emitting devices. We attempted a simple approach to synthesizing luminescent graphene, *i.e.* noncovalent physical adsorption of a luminescent Eu complex ($EuLC_{18}$: Fig. 1(a)) on the surface of the graphene sheets grown by chemical vapor deposition (CVD). An amphiphilic complex, $EuLC_{18}$, has bipyridine ligands to wind the Eu ion and two long alkyl chains ($C_{17}H_{35}$). The bipyridine ligands, which act as photo-antennae, effectively absorb the photo-excitation energy and transport it for the Eu excitation while sensitizing the sharp ff emissions of Eu ions with high efficiency (photo-antenna effect)[1][2]. In the synthesizing of $EuLC_{18}$-adosorbed graphene sheets, the CVD-grown graphene sheets, which were transferred onto non-luminescent quartz substrates, were simply dipped in a chloroform solvent for five minutes, in which $EuLC_{18}$ was dissolved with a concentration of 1 mM. The $EuLC_{18}$/graphene sheet showed bright red-color luminescence under UV lgith irradiation as shown in Fig.1 (b). The luminescence spectrum of the $EuLC_{18}$/graphene sheet under photo-excitation at a wavelength of 290 nm is shown in Fig.1(c). Several luminescence peaks were clearly observed in a wavelength region from 580 to 694 nm. The luminescence peaks at 591, 616.5, and 694 nm correspond to the ff emissions of the trivalent Eu ion. These peaks can be assigned to the $^5D_0 \rightarrow {}^7F_1$, $^5D_0 \rightarrow {}^7F_2$, and $^5D_0 \rightarrow {}^7F_4$ transitions, respectively. We confirmed through the measurements of the excitation spectrum that the light emission typical for ff transitions of the Eu ion was obtained via the energy transfer from the ligand to the Eu ions by the photo-antenna effect. We have demonstrated that ultrathin graphene sheets can be made luminescent simply through adsorption of $EuLC_{18}$ on the graphene surface.

References

[1] M. Hasegawa, et al., New J. Chem. 38, 1225 (2014).
[2] S. Ogata, A. Ishii, M. Hasegawa, et al., New J. Chem. 41, 6385 (2017).

Figures

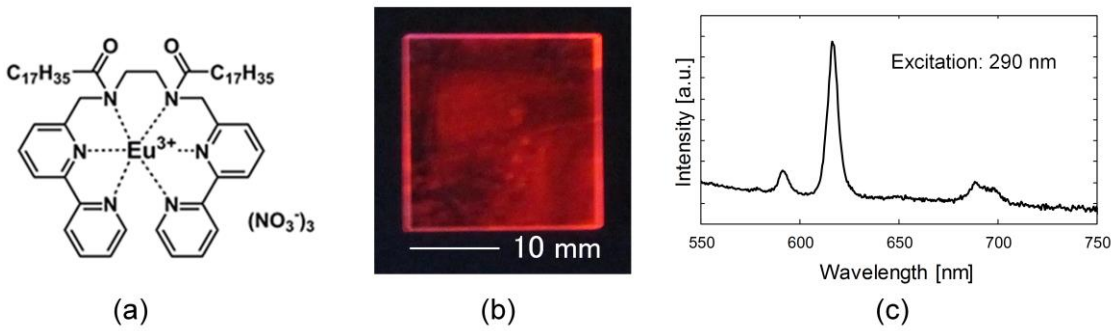

Figure 1: (a) Structure of $EuLC_{18}$ (b) $EuLC_{18}$/graphene sheet under UV light irradiation and (c) luminescence spectrum