17a-S10-10

Synthesis and properties of molecule-doped diamond-like carbons

W. Xie[1], A. Kawahito[1], T. Yanase[2], T. Nagahama[3], T. Shimada[3]
Graduate School of Chemical Science and Engineering[1] and
Frontier Chemistry Center[2] and Division of Materials Chemistry[3], Faculty of Engineering,
Hokkaido University, Sapporo, Hokkaido, 060-8628, Japan

Email: Syai@ec.hokudai.ac.jp

Diamond-like carbon (DLC), as a kind of amorphous carbon materials with both sp^2 and sp^3 carbons, has many interesting and useful properties. It is expected that these properties such as in optics and electronics can be adjusted if we finely tune the nanoscale arrangement of sp^2 and sp^3 carbon atoms and synthesize the nano-structures[1]. In this work, we will introduce our attempt to "dope" organic molecules (C_{60}, PTCDA and CuPc) into the DLC film to improve the properties. The DLC film was synthesized by Plasma Assisted Chemical Vapor Deposition (PACVD)[2]. The organic molecules were doped into the film by sublimation at an appropriate temperature respectively. Surprisingly, the C_{60} - doped DLC samples exhibit brilliant colors, which cover most of the visible region wavelength as shown in Fig. 1. We noticed that the iridescence color appeared only after we exposed the samples to the atmosphere containing water vapor.

The angular dependence of the color exhibits the feature of "structural color" caused by 10 nm - 100 nm structures and their superstructures. In order to confirm it, we took the cross-section images of the film by SEM and TEM as shown in Fig. 2. The C_{60}-DLC film is constructed by many popcorn-like nanostructures with various sizes. The film thickness and quasi periodic lateral structure [3, 4] are combined with nanostructures to exhibit characteristic colors of the samples. The Raman and IR spectra show the film is not much different from ordinary DLC, which proves that the vivid colors are due to the popcorn-like nano structures.

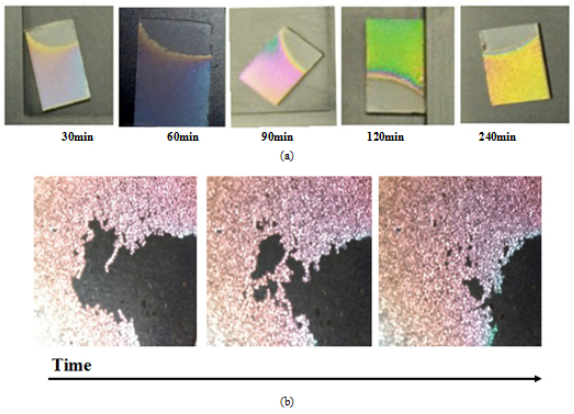
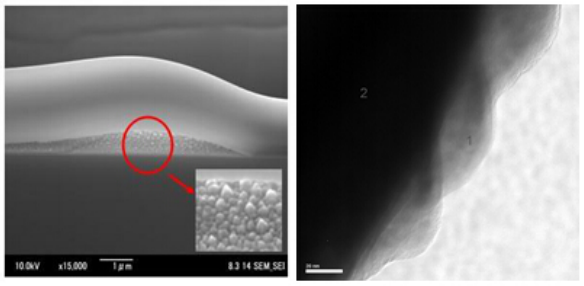


Fig.1 (a) Photograph of iridescence colors (b) The entire process of the iridescence appearing



（a)　　(b)

Fig. 2 (a) Cross section SEM of a colored film (b) TEM image of the interface structure between popcorn-like films and the substrates

References

[1] N. Keller, N. I. Maksimova, et al, *Angew. Chem., Int. Ed. Engl*. 41, 1885 (2002).
[2] J. C. Richley, M. W. Kelly, ea al, *J. Phys. Chem. A* 116, 9447 (2012).
[3] V. Sharma, M. Crne, et al, *Science* 325, 449(2009).
[4] J. A. Kelly, A. M. Shukaliak, et al, *Angew. Chem., Int. Ed. Engl*. 52, 8912(2013)