Organic field-effect transistors based on newly synthesized dibenzo[n]phenacenes (n = 5 - 7)

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The extended phenacene molecules, [n]phenacenes (n = 5 to 11), that consist of fused benzene rings taking a W-shaped structure, have been synthesized, and the field-effect transistors (FETs) using their molecules were successfully fabricated, demonstrating excellent performance with the high field-effect mobility [1]. The [n]phenacene and phenacene derivatives show high air-stability, compared with acene type molecules like pentacene. Therefore, the synthesis of new types of phenacene derivatives is of significance to realize high-performance FETs without degradation under atmospheric condition.

In this study, a new type of phenacene molecules, dibenzo[n]phenecenes (DBnPs, n = 5 to 7), were synthesized *via* a combination of Migita-Kosugi-Stille and Heck-Mizorogi cross coupling reactions followed by Mallory photocyclization. Physical properties and FET performance were investigated for thin films and single crystals of DBnPs. The X-ray diffraction patterns of DBnP thin films formed on a SiO_2/Si substrate suggested that the inclined angle of the long molecular axis with respect to a normal direction of a substrate surface decreased with an increase in n of DBnP, because of stronger π-π interaction due to an increase in the number of benzene rings. The FETs using DBnP single crystals were fabricated, which showed good p-channel properties. The average values of field-effect mobility of DBnP (n = 5 to 7) single crystal FETs were 1.3(8), 1.7(8), and 1.8(5) $cm^2\ V^{-1}\ s^{-1}$, respectively. Details of FET characteristics of DBnP (n = 5 to 7) single crystals will be discussed in my talk.

[1] R. Eguchi *et al*., Phys. Chem. Chem. Phys. **15**, 20611 (2013); H. Okamoto *et al*. Sci. Rep. **4**, 5330 (2014); Y. Shimo *et al*., Sci. Rep. **6**, 21008 (2016); H. Okamoto *et al*., Sci. Rep. **9**, 4009 (2019).

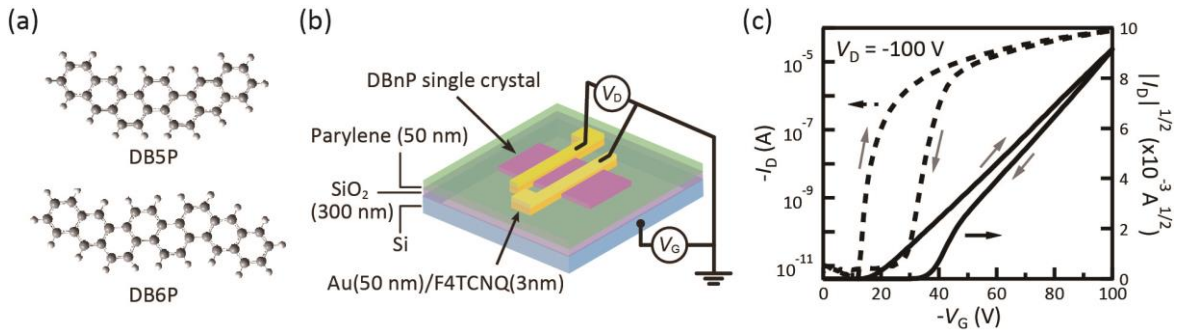

Figure 1. (a) Molecular structures of DB5P and DB6P. (b) Device structure of the DBnP single crystal FETs with a SiO_2 gate dielectric. (c) Transfer curves of the DB6P single crystal FET with a SiO_2 gate dielectric.