Quantitative analysis of organic anti-ambipolar field-effect transistors II

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In recent years, anti-ambipolar transistors (AATs) have received widespread interest due to the characteristic negative differential resistance (NDR) [1]. In our previous work, AATs were quantitatively analyzed based on a series circuit consisting of N- and P-type transistors [2]. In this work, electrical behavior of AATs containing a PN junction is compared with that of series transistors.

AATs are constructed from P-type dibenzotetrathiafulvalene (DBTTF) and N-type cyclohexyl-naphthalenediimide (Cyh-NDI) transistors. The transfer and output characteristics of the series transistors (Fig. 1(a)(b)) are well represented by $I_D = (\mu_e CW/2L)(V_G - V_{th}^e)^2$ and $I_D = (\mu_h CW/2L)(V_G - V_D - V_{th}^h)^2$ [2], where μ_e = 0.038 and μ_h = 0.003 cm^2/Vs. In particular, the output characteristics becomes constant above $V_D > 2V_G$ (Fig. 1(b)). Electrical characteristics of AATs shows a similar tendency (Fig. 1 (c)(d)), but I_D is smaller. The difference comes from the contribution of the PN junction.

[1] Y. Wakayama, *et al.*, *Adv. Funct. Mater*. **30**, 1903724 (2020).

[2] Junyi Zhu, Takehiko Mori, "Quantitative Analysis of Organic Anti-ambipolar Field-effect Transistors", the 82nd JSAP Autumn Meeting,12p-N205-7, Sep. 2021.

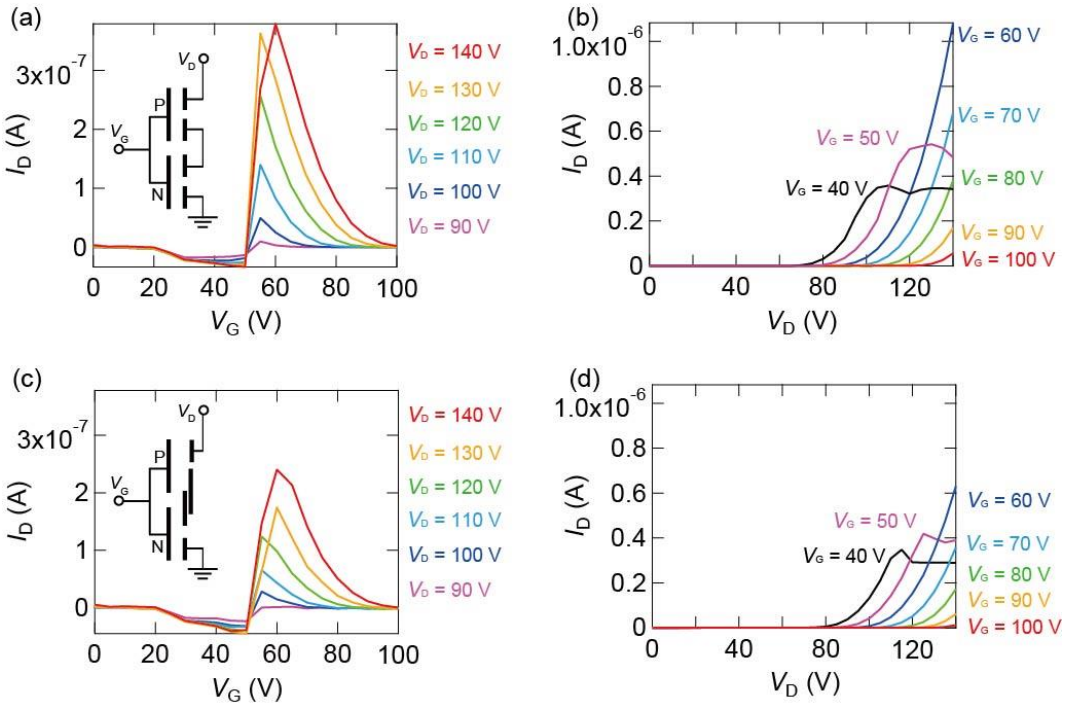

Fig. 1. Transfer (a) and output (b) characteristics of series transistors and (c)(d) AATs.