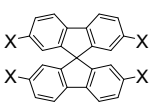
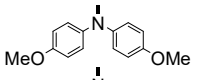
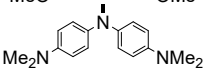
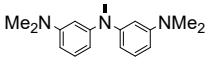
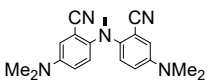
ペロブスカイト太陽電池用スピロ型ホール輸送材料のドーパントフリー化における置換基の影響

（日本精化株式会社[1]・産総研[2]）○土屋 大輔[1]・井上 真一[1]・上野 敏哉[1]・小野澤 伸子[2]・古郷 敦史[2]・舩木 敬[2]・近松 真之[2]・村上 拓郎[2]
Substituents effects of spirobifluorene-based dopant-free hole-transporting materials for perovskite solar cells ([1]*Nippon Fine Chemical Co., Ltd*., [2]*National Institute of Advanced Industrial Science and Technology (AIST)*) ○ Daisuke Tsuchiya,[1] Shinichi Inoue,[1] Toshiya Ueno,[1] Nobuko Onozawa-Komatsuzaki,[2] Atsushi Kogo,[2] Takashi Funaki,[2] Masayuki Chikamatsu,[2] Takurou N. Murakami[2]

Various spiro-type hole-transporting materials (HTMs) for perovskite solar cells (PSCs) were newly synthesized. The PSCs by using these HTMs with or without dopants were fabricated, and their solar cell performance were evaluated. As a result, for a new HTM obtained by replacing p-methoxy substituents in spiro-OMeTAD with dimethylamino groups, it was found that there is almost no significant difference in cell performance between with and without dopants. The effects of the substitution position of the dimethylamino groups and the introduction of additional substituents on the cell performance were also investigated.
Keywords： Perovskite solar cells; hole-transporting materials; dopant free

ペロブスカイト太陽電池は高効率で安価な次世代型太陽電池として注目を集めている。今回、我々は種々のホール輸送材料を新規に合成し、それらを用いたペロブスカイト太陽電池を作製して性能を評価した。その結果、Spiro-OMeTAD の OMe 基を NMe_2 基に置換した場合、ドーパントフリーでも性能にほとんど差異がないと判明した。さらに NMe_2 基の置換位置や追加の置換基等を検討した結果、CN 基と NMe_2 基を有するホール輸送材料を用いた太陽電池がドーパントフリーでも高い変換効率を示し、耐久性も向上することがわかった。

Table 1. HOMO energy levels (E_{HOMO}) of spiro-type HTMs and power-conversion efficiencies (PCEs) of PSCs using them with or without dopant. Device structure is FTO/c-TiO_2/meso-TiO_2/$MAPbI_3$/HTMs/Au.

Chemical structure of HTMs	E_{HOMO}(eV)[a]	PCE (%) (with dopant)	PCE (%) (without dopant)
 X = 	-4.81	17.6	13.1
X = 	-4.43	12.6	12.1
X = 	-4.82	16.9	8.6
X = 	-4.83	15.2	16.2

[a] E_{HOMO} was estimated by the differential pulse voltammetry (DPV) method.