

## 半導体カーボンナノチューブを PEDOT:PSS に添加した有機薄膜太陽電池

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Organic solar cells (OSCs) have been expected to be one of the most promisingly wearable energy-harvesting devices owing to their lightweight, flexibility and facile production. Hole-transporting layer (HTL) is one of the critical component for an efficient OSCs, and PEDOT:PSS has demonstrated superior prospect owing to its ease of production and preservation. However, the pristine PEDOT:PSS generally gives a fair performance, which results from the low conductivity of insulating PSS, unfavored conductive band energy level ( $E_{CB}$ ), and poor interfacial morphology. Herein, this study improved the PEDOT:PSS for an efficient OSCs by using semiconducting single-walled carbon nanotubes (sc-SWCNTs) as an additive to PEDOT:PSS, which has high conductivity and is thought to wait for the property of intertwining with polymers.

The results showed that when 5 wt % of sc-SWCNTs aqueous solution was added to PEDOT:PSS, the efficiency of OSCs achieved an efficiency of 7.28% on a PBTZT-stat-BDIT-8:PCBM-type OSC. Moreover, thanks to the hydrophobicity of sc-SWCNTs-doped PEDOT:PSS, the device was able to maintain 80% of its efficiency after one month.

**Keywords :** Organic solar cells; Carbon nanotubes; Organic semiconductor;

有機太陽電池(OSCs)は軽量で柔軟性を持ち、安価に作製できる環境発電デバイスの一つとして現在注目されている。そして正孔輸送層の材料として成膜の簡単さや一定の性能を持つ点で PEDOT:PSS が広く使われている。しかし、純粋な PEDOT:PSS では PSS の持つ絶縁性による導電性の低さやエネルギーレベルの不一致、表面状態の悪さが原因で高性能な OSCs を作製できていない。そこで、本研究では半導体単層カーボンナノチューブ(sc-SWCNTs)を PEDOT:PSS に添加することで導電性の向上、エネルギーレベルの調製、表面状態の改善に取り組んだ。その結果、PEDOT:PSS に 5 wt % の sc-SWCNTs 水溶液を添加することで PBTZT-stat-BDIT-8 を用いた OSC で変換効率 7.28%を達成した。さらに、sc-SWCNTs の疎水性により表面状態が改善され、一ヶ月後にエネルギー変換効率の 8 割を維持することができた。

HTL	$V_{oc}$ (V)	FF	PCE <sub>best</sub> (%)
PEDOT:PSS	0.790 [0.778±0.007]	0.69 [0.69±0.002]	7.04
PEDOT:PSS+sc-SWCNTs(aq)5wt%	0.805 [0.783±0.012]	0.74 [0.75±0.005]	7.28