半導体高分子の精密合成と有機エレクトロニクス材料への応用

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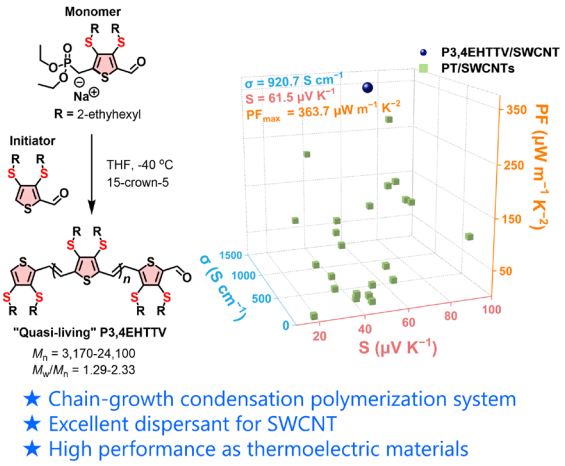
Controlled Synthesis of Semiconducting Polymers Suited for Organic Electronics ([1]*Graduate School of Organic Materials Science, Yamagata University*, [2]*Department of Materials Science and Engineering, National Taiwan University*) ○Tomoya Higashihara,[1] Koya Nishiyama,[1] Cheng-Liang Liu,[2]

Semiconducting polymers are lightweight, low cost, and easy to manufacture, making them promising candidates for application in electronic devices. In this study, poly(thienylene vinylene) (PTV) with alkylthio side chains, poly[3,4-bis(2-ethylhexylthio)thienylene vinylene] (P3,4EHTTV), was successfully synthesized using an environmentally friendly polymerization system employing neither transition-metal catalysts nor halogens. The polymerization proceeded *via* a chain-growth mechanism, exhibiting a “quasi-living” nature. P3,4EHTTV was then combined with single-walled carbon nanotube (SWCNT) to fabricate nanocomposite thin films with thermoelectric (TE) properties. The P3,4EHTTV/SWCNT composite system showed favorable charge distribution and improved alignments in the energy levels, contributing to considerably improved TE properties, with a record-breaking power factor of 363.7 μW m^{-1} K^{-2}. These findings highlight the importance of structural design in PTV and alkylthio side-chain engineering for optimizing TE performance.
Keywords : Semiconducting Polymer; Living Polymerization; Environmentally Friendly; Carbon Nanotube; Thermoelectric.

本研究では、遷移金属触媒やハロゲンを用いない環境に優しい縮合的連鎖重合法に基づき、アルキルチオ側鎖を有するポリ［3,4-ビス（2-エチルヘキシルチオ）チエニレンビニレン］（P3,4EHTTV）を精密合成することに初めて成功した[1)]。P3,4EHTTV と単層カーボンナノチューブ（SWCNT）とからなるナノコンポジット薄膜を用いた有機熱電変換素子を作製・評価したところ、半導体高分子/CNT 系ナノコンポジット材料における世界最高水準のパワーファクター値（363.7 μ W $m^{-1}K^{-2}$）を示し、本開発ポリマーが高い熱電変換機能を有する SWCNT 分散材料として有望であることが分った。



1) Environmentally Friendly Controlled Synthesis of Poly(thienylene vinylene) with Alkylthio Side Chains and Application to Thermoelectric Materials. K. Nishiyama, Y.-T. Hsiao, W.-N. Wu, J.-M. Lin, S.-H. Tung, C.-L. Liu, T. Higashiharaa, *J. Mater. Chem. A* **2024**, *12*, in press.