Defect-Free Ladder Polymers with a One-Handed Helical Geometry: Synthesis and Application

([1]*Graduate School of Engineering, Nagoya University*, [2]*JST PRESTO*) ○Tomoyuki Ikai,[1,2]
Keywords: Chirality; Ladder polymers; Helical polymers; Secondary structures; π-Extension

Advances and modifications in a practical synthetic methodology expand the repertoire of molecules and polymers accessible to chemists and would lead to dramatic innovations in the materials science.

Ladder polymers are ladder-shaped macromolecules, in which the adjacent cyclic monomer units are linked by two or more chemical bonds, and their conformational freedom is severely restricted by the ladder framework, resulting in their shape-persistent nature and thermal/mechanical stability.[1,2] Structurally well-defined ladder polymers without undesired branching structures and/or imperfect ladder structures remain challenging synthetic targets for organic and polymer chemists. Recently, we have succeeded in the defect-free synthesis of a series of ladder polymers with a rigid helical geometry, namely, helical ladder polymers,[3–7] and the optically-pure single and multiple helicenes[8,9] and their analogues[10] using acid-promoted intramolecular alkyne benzannulations[11] with or without combining chromatographic enantioseparations. In this presentation, we will introduce the design and synthesis of such chiral ladder architectures along with their chiral functions, particularly in relation to circularly polarized luminescence and chiral recognition.

1) J. Lee, A. J. Kalin, T. Yuan, M. Al-Hashimi, L. Fang, *Chem. Sci.* **2017**, *8*, 2503. 2) Y. C. Teo, H. W. H. Lai, Y. Xia, *Chem. - Eur. J.* **2017**, *23*, 14101. 3) T. Ikai, T. Yoshida, K. Shinohara, T. Taniguchi, Y. Wada, T. M. Swager, *J. Am. Chem. Soc.* **2019**, *141*, 4696. 4) W. Zheng, T. Ikai, E. Yashima, *Angew. Chem., Int. Ed.* **2021**, *60*, 11294. 5) W. Zheng, K. Oki, R. Saha, Y. Hijikata, E. Yashima, T. Ikai, *Angew. Chem., Int. Ed.* **2023**, *62*, e202218297. 6) T. Ikai, S. Miyoshi, K. Oki, R. Saha, Y. Hijikata, E. Yashima, *Angew. Chem., Int. Ed.* **2023**, *62*, e202301962. 7) T. Ikai, A. Tanaka, T. Shiotani, K. Oki, E. Yashima, *Org. Mater.* **2023**, *5*, 184. 8) T. Ikai, S. Yamakawa, N. Suzuki, E. Yashima, *Chem. - Asian J.* **2021**, *16*, 769. 9) T. Ikai, K. Oki, S. Yamakawa, E. Yashima, *Angew. Chem., Int. Ed.* **2023**, *62*, e202301836. 10) W. Zheng, T. Ikai, K. Oki, E. Yashima, *Nat. Sci.* **2022**, *2*, e20210047. 11) M. B. Goldfinger, T. M. Swager, *J. Am. Chem. Soc.* **1994**, *116*, 7895.