ASPIRE League Partnership Seed Fund
1st (2019) Round – Project 4
Research Project Summary

Q1. Title of Research Project
Electronic Devices Based on Chiral Organic Semiconductors

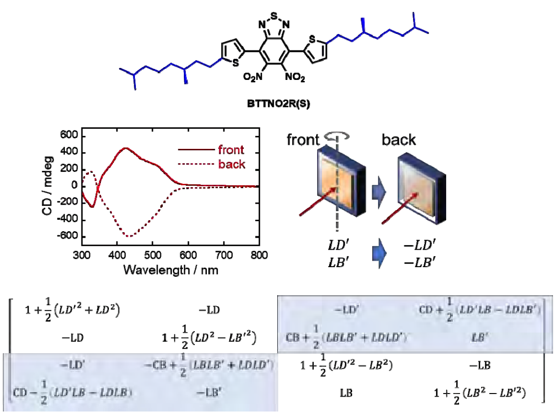
Q2. Timeframe
Project Start: 01/10/19 Project Completion: 31/10/21

Q3. Project Synopsis

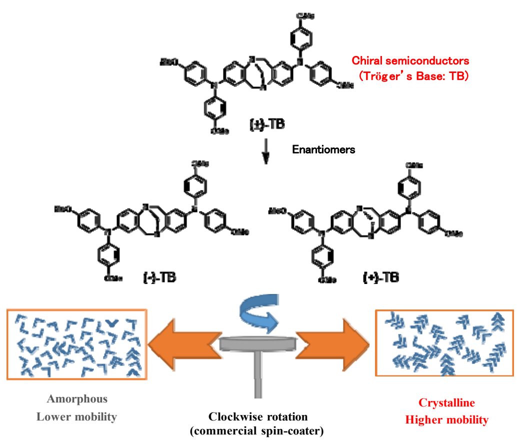
In this project, we developed a series of chiral organic semiconductors, evaluated chiroptical properties, and fabricated their thin film electronic devices. The final goal of this study is to establish a new methodology of producing high mobility organic thin films featuring additional chiroptical properties. Organic semiconductors and semiconducting polymers possessing chiral subunits have been studied as key components of supramolecular self-assembly and chiroptical sources, but their electrical or charge-transporting properties are relatively unexplored. Therefore, it is expected that developing high-mobility chiral organic semiconductors will give a large impact to the community.

In our previous ASPIRE league project, we employed fused aromatic units, such as benzobisthiadiazole, as a backbone component of high mobility semiconducting polymers. It was found that the intermediate benzothiadiazole compound substituted by chiral alkyl chains shows an interesting LDLB effect, which enables to discriminate the illumination direction of samples, i.e., from the front or back.

In addition to chiral alkyl chains, we also tested chiral aromatic units, such as Tröger's base (TB). Enantiopure Tröger's base derivatives were successfully isolated by using a chiral HPLC and their hole-transporting properties were investigated. It was found that the hole mobilities of the enantiopure Tröger's base films depend on the rotational direction of spin-coating, i.e., clockwise or counter-clockwise. Furthermore, the hole mobilities have a correlation to the photovoltaic performances when the hole-transporting layer of perovskite solar cells was fabricated by spin-coating of the developed Tröger's bases.



LDLB effect of a benzothiadiazole derivative with chiral alkyl chains



Thin films of chiral Tröger's bases formed by spin-coating