

## Carboxyl-substituted Poly(quinoxaline-2,3-diyl) for Quantification of a Small Enantiomeric Imbalance of Chiral Amines by CD Spectroscopy in Water

(Graduate School of Engineering, Kyoto University) ○Tomonori Yamawaki, Takuma Kuroda, Yuuya Nagata, Michinori Suginome

**Keywords:** Helical Chirality; Asymmetric Amplification; Chiral Discrimination; CD Spectroscopy; Acid-base Interaction

Quantification of enantiomeric ratio of chiral compounds is an important basis in the development of chiral science. Chromatography using a chiral stationary phase and NMR measurement using a chiral shift reagent are widely employed as useful chiral quantification methods. However, since these methods rely on quantification of the peak integration ratios of enantiomer signals, it is difficult to evaluate small enantiomeric imbalance. To overcome this problem, induced CD method using dynamic helical polymers has attracted much attention since a small enantiomeric imbalance of chiral compounds can be detected as amplified CD signals of polymers. Nevertheless, only limited helical polymers have been applied for the highly sensitive chirality detection. Poly(quinoxaline-2,3-diyl)s (PQXs) are known as helical polymers with long persistence length, which facilitates quantitative evaluation of the chiral amplification effect.<sup>1,2</sup> In this study, we investigated helical chirality induction of achiral **P(100)** bearing carboxyl side chains, which leads to the quantification of a small enantiomeric imbalance of chiral amines through acid-base interaction.

The helical chirality induction of achiral **P(100)** using (*S*)-1-phenylethylamine (**PEA**) with varied ee (10 mM) was investigated by CD measurements in water (Fig. 1a). Kuhn dissymmetry factor  $g_{\text{abs}}$  ( $\Delta\epsilon/\epsilon$ ) at 370.5 nm is plotted against the ee of (*S*)-**PEA** (Fig. 1b). The  $g_{\text{abs}}$  values of **P(100)** increased nonlinearly with the increase of the ee of **PEA**, enabling the detection of extremely low optical purity (down to 0.1% ee). Notably, the observed  $g_{\text{abs}}$  values against **PEA** with low optical purity ( $\leq 1\%$  ee) can be approximated to a linear relationship (Fig. 1b, inset). The CD spectrum of **P(100)** in aqueous solution of purchased racemic **PEA** showed the induction of a left-handed helical structure (Fig. 1c). This result suggests that the purchased lot of racemic **PEA** has a slight enantiomeric imbalance (0.6% ee (*S*)).

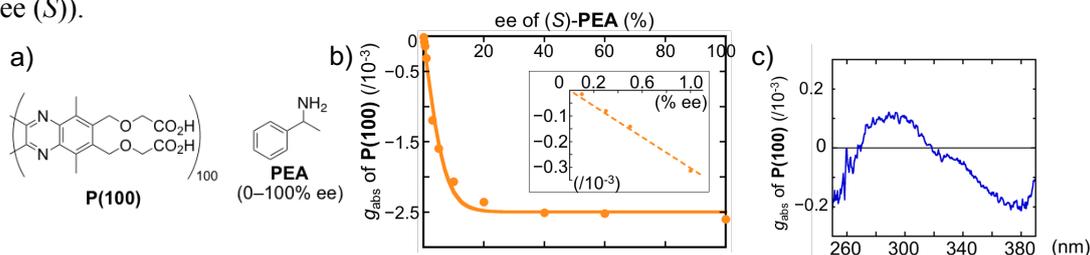


Fig. 1. a) The structure of **P(100)** and **PEA**. b) The relationship between ee of **PEA** and  $g_{\text{abs}}$  of **P(100)** at 370.5 nm. The inset shows linear approximation between ee and  $g_{\text{abs}}$  at the low ee range. c) The CD spectrum of **P(100)** in aqueous solution of purchased racemic **PEA**. **P(100)**; 0.09 mM as monomer unit, **PEA**; 10 mM.

- 1) Yamamoto, T.; Murakami, R.; Komatsu, S.; Suginome, M. *J. Am. Chem. Soc.* **2018**, *140*, 3867–3870.
- 2) Nagata, Y.; Takeda, R.; Suginome, M. *ACS Cent. Sci.* **2019**, *5*, 1235–1240.