Futurum
Tsukuba Science Journal

Brief report

Chiral Electrode

Selective Detection of Chiral Materials with Electrochemical Method

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ABSTRACT

A chiral polyaniline is applied for chiral detection of 3,3-dimethyl-2-butylamine (DBA). During the cyclic voltammetry (CV) measurements, a reduction signal was selectively detected in the presence of 3,3-dimethyl-2-butylamine (DBA).

Keywords: chiral polyaniline; electrochemistry; modified chiral electrode

Introduction

PANI has been well studied in basic and application view points [1], such as formation of helical structure, buffer layer of EL devices, anti-corrosion, condenser, polymer transistor, and anti-electrostatic sheet [2].

In the previous study, a polyaniline derivative bearing optically active substituent has been synthesized, and proposed a possibility of an optically active electrode that can selectively detect a chiral molecule as an electronic signal [3].

In this research, the chiral polyaniline is employed for chiral recognition of chiral molecules, (*R*) or (*S*)-3,3-dimethyl-2-butylamine (DBA).

Polyanilines bearing chiral substituent was prepared previously [2]. The polyanilines are abbreviated as polyR and polyS, Figure 1. (*R*) or (*S*)-3,3-dimethyl-2-butylamine is abbreviated as R-DBA and S-DBA. Molecular structure of DBA is shown in Figure 2.

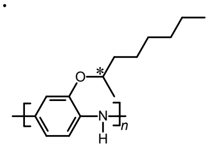
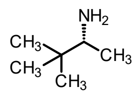
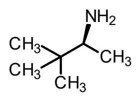


Figure 1. Molecular structure of polyaniline bearing chiral substituent. * = chiral carbon.



(*R*)-3,3-Dimethyl-2-butylamine (R-DBA)



(*S*)-3,3-Dimethyl-2-butylamine (R-DBA)

Figure 2. Molecular structures of 3,3-dimethyl-2-butylamine (DBA). * = chiral carbon.

PolyR and PolyS were respectively dissolved in tetrahydrofuran (THF). The polymer solution was dropped onto a Pt plate and naturally evaporated to prepare cast film. This polymer modified electrode was used as working electrode. Next, trace amount of R-DBA or S-DBA was dissolved in 10 mL of 0.1 M acetonitrile.

Although CV measurements of R-DBA or S-DBA in 0.1 M acetonitrile solution shows no characteristic signal, the CV selectively shows reduction signal in the presence of R-DBA and S-DBA, Figure 3. This can be due to the fact that adsorption property derived from 3D-chemical structure of chiral materials onto the chiral polyaniline, Figure 4. A key point of the electrochemical/chiral detection mechanism is chiral adsorption on the surface of the working electrode. External forces (gravity, pressure) drive column chromatography. The chiral electrode in the present study is driven by movement of ions, comparable to electrophoresis.

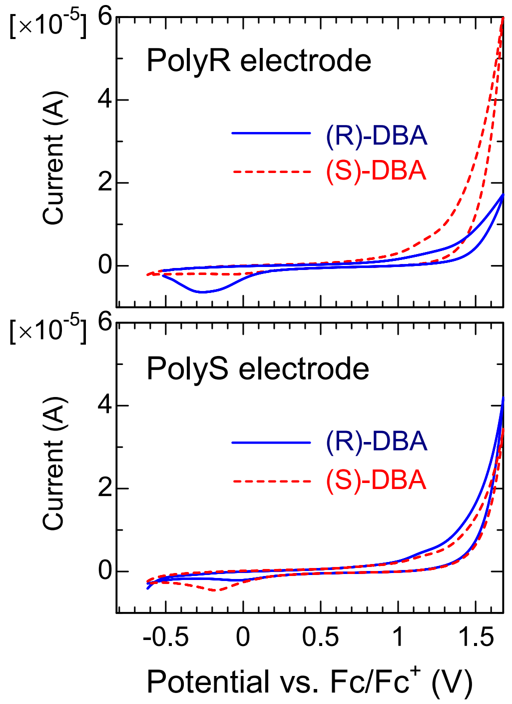


Figure 3. Cyclic voltammetry (CV) results for PolyR and PolyS working electrodes in the presence of (R)-DBA or (S)-DBA.
DBA = 3,3-dimethyl-2-butylamine.

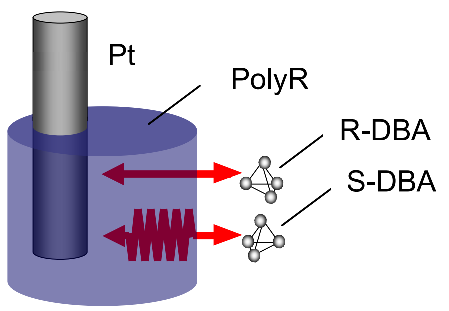


Figure 4. Possible mechanism of electrochemical selective recognition of chiral materials by the chiral polyaniline.

We attempted electrochemical detection of chiral molecules, however detection mechanism needs to be further evaluated in the future. Chiral recognition function of chiral column chromatography developed by Okamoto *el. al.* can be important in consideration for the electrochemical selective detection system [4]. Here, helical formation and π-stacking [5] can be related to the chiral selective adsorption.

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Received: January 6, 2018.
Accepted: January 10, 2018.

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