

# Chiral D-/L-Penicillamine-protected Ag Triangular Nanoplates Synthesized by Substitution Reaction

Naoki Nishida, Yasuhiro Kojima and Hideki Tanaka

Department of Applied Chemistry, Faculty of Science and Engineering, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo 112-8551, Japan

nnishida@kc.chuo-u.ac.jp

## Abstract

Ag triangular nanoplates have attracted much attention due to their unique geometric structures and optical properties. These unique points are known to be complementary to each other since their optical properties are induced by surface plasmon resonances (SPR) that originate from their structure. Meanwhile, studies of nanoscale chirality have attracted much interest because they have potential in a wide variety of areas such as catalytic and optical applications. Recently, we reported the synthesis of Ag triangular nanoplates protected by chiral glutathione molecules [1]. These nanoplates showed characteristic Cotton effects which were induced by SPR of nanoplates. However, we have prepared Ag nanoplate protected by only one of the enantiomeric species. Herein, we examined synthesis of chiral Ag triangular nanoplates protected by a pair of enantiomers.

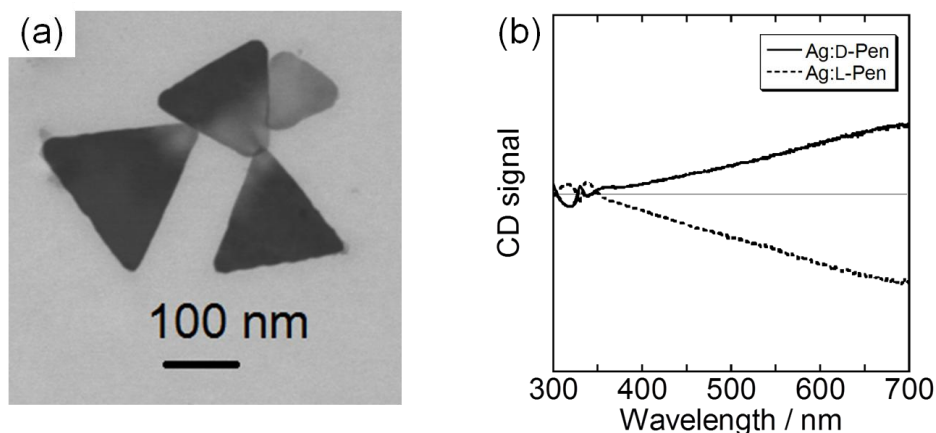
Ag:PVP (polyvinylpyrrolidone) triangular nanoplates were prepared by photoreduction of silver nitrate ethanol solution as described previously [2]. Subsequently, Ag:Pen (D- or L-penicillamine) nanoplates were synthesized by substitution reaction of Ag:PVP nanoplates with Pen molecules: the Ag:PVP dispersion was mixed and stirred with Pen water solution at room temperature and the formed precipitate was redispersed with water. The structures of the products were observed by scanning transmission electron microscopy (STEM). Additionally, the chiroptical properties were analyzed by circular dichroism (CD) spectroscopy.

Figure 1a shows a STEM image for Ag:D-Pen nanoplates. The triangular nanoplates are observed in the STEM image. This indicates that triangular shape of nanoplates is not affected by the present substitution process. As shown in Figure 1b, the CD spectra of Ag:Pen nanoplates exhibited intense Cotton effects with a broad distribution above 500 nm and an almost perfect mirror-image relationship. The wavelength for the distribution was completely different from those for the Pen molecules but was similar to those for the characteristic SPR of nanoplates. Furthermore, the mirror image relationship in CD spectra indicates that chiral nanoplates are synthesized by substitution reaction of the chiral Pens.

## References

- [1] N. Nishida, Y. Kojima, H. Tanaka, *Chem Lett*, **41** (2012) 926.
- [2] H. Murayama, N. Hashimoto, H. Tanaka, *Chem. Phys. Lett*, **482** (2009) 291.

## Figures



**Figure 1** (a) STEM image for Ag:D-Pen nanoplates. (b) CD spectra for Ag:D-/L-pen nanoplates.