

HELICAL GOLD NANOPARTICLE ASSEMBLIES: EMERGENCE OF PLASMONIC CHIRALITY

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Helical assemblies of gold nanoparticles are prepared on thermoresponsive organic templates, showing circularly dichroism response in the spectral region of the plasmon resonance.

Keywords: metal nanoparticles, plasmonic chirality

1. Introduction

Chiral metallic nanostructures are an emerging class of optical materials with exciting potential applications as chiroptical sensors, circular polarizers, perfect lenses, etc. [1]. The group of Prof. K.G. Thomas from IISER-TVM developed a new method for the preparation of free standing gold nanoparticle arranged in helical assemblies [2], that show a prominent circular dichroism (CD) response. The CD response is discussed adopting a model proposed by Govorov [3].

2. Results and Discussion

Chiral Au nanoparticles are grown on chiral organic templates (D- and L- forms of alanine functionalized phenyleneethylenes), forming helical assemblies of nanoparticles (see Fig.1). The organic template shows a CD signal in the 300-400nm region (Fig. 1, panel A). After growing the gold nanoparticle on the template, the CD spectrum show a new signal in the spectral region of the plasmonic resonance (500-600nm). The removal of the organic template is obtained by increasing the temperature, as it is demonstrated by the CD spectrum in panel C of Figure 1, where only the plasmonic CD response is observed.

The geometry of the chiral assembly is investigated through the analysis of high resolution TEM images, that allows to reasonably estimate the dimension of the nanoparticles and the geometrical parameters of the formed helix.

Experimental CD spectra are rationalized adopting a model developed by Govorov [3], that accounts for the large polarizability of the metal nanoparticles: calculated CD spectra compares well with experimental data.

The model for plasmonic aggregate is compared to the exciton model, that is commonly adopted for supramolecular aggregates. The aim of the comparison is to rationalize the nature of the interactions responsible for chiroptical properties of the two systems.

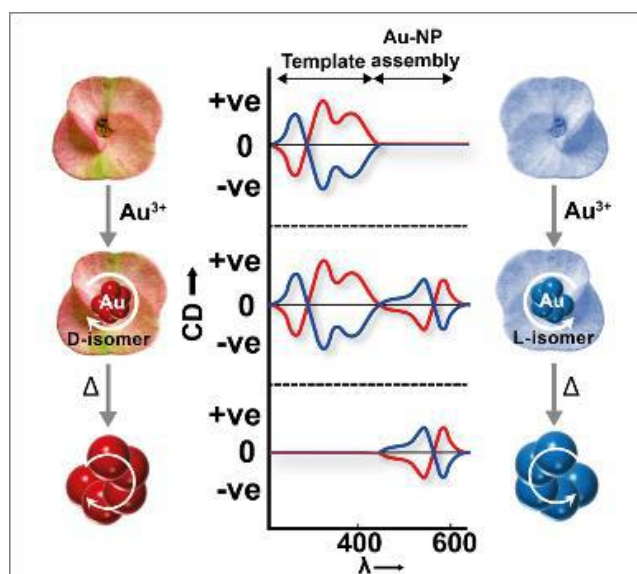


Fig. 1 CD spectra of the organic template showing a non-bisignated structure, of the template decorated with Au nanoparticles, and of the chiral plasmonic structure obtained upon dissolution of the organic template. On the left and the right side of the figure a schematic view of the plasmonic structure, as estimated from TEM images

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