Nanoplasmonic Sensing by Silver Nanoplates Generated by Pulsed Laser Ablation and Reirradiation in Liquids

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Introduction

One of the most common methods to generate and modify noble metal colloids in liquid phase consists in the formation of metallic seeds by salt reduction and subsequent growth of nanostructures by specific light exposure. However, these methods use a number of chemicals, such as aggressive reducing agents, beside metallic salts.

An alternative and greener way to generate silver and gold colloids is the use of pulsed laser ablation of a metallic target in the liquid phase. This technique has so far been reported for the formation of spherical nanoparticles in the colloidal form with sizes ranging from 5 to 20 nm.

Here, we demonstrate a green, chemical-free synthesis of silver nanoplates by pulsed lased ablation in liquids and their application in nanoplasmonic sensing.

Methods

Silver seeds have been produced by the ablation of a metallic target in water using the second harmonics of a nanosecond pulsed Nd:YAG laser (532 nm). To obtain silver nanoplates, $H_2O_2$is added to the obtained silver colloidal solutions under continuous irradiation by a narrow band LED lamp at 600 nm in a suitable reactor. Electron and Atomic Force microscopies have been performed to characterize the size and shape of the produced nanoparticles.

For nanoplasmonic sensing, the refractive index of the medium is tuned in a range between 1.33 and 1.46 by adding a sucrose solution to existing nanoplates solutions, while PR is measured by UV-Vis-NIR spectroscopy.

Results and discussion

Spectroscopic and microscopic characterizations reveal that the final colloid consists of triangular and hexagonal silver nanoplates with in-plane size of about 150 nm and thickness around 20 nm. Under LED illumination the in-plane plasmon resonance position changes from 400 nm to 700 nm as shown in figure 1. Figure 2 shows a range of absorption spectra of a specific colloidal sample in a glucose solution as the refractive index increases. The inset shows the results of nanoplasmonic sensing experiments with a sensitivity of up to 450 nm/RIU.

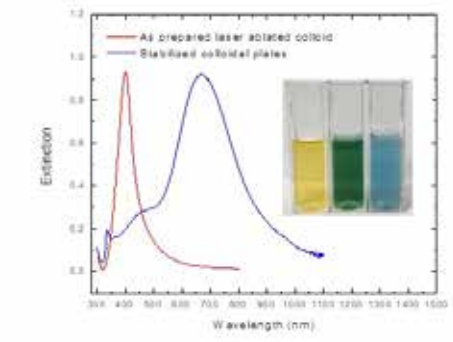

Fig1.jpg

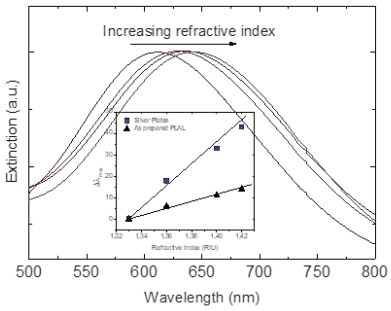

Fig2.png