CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

S0610

Project Title

Synthesis and Manipulation of Silver and Gold Nano-Mirrors

Abstract

Objectives/Goals

Reflective nanoplates, or nano-mirrors, have shown to be good candidates for applications such as liquid mirrors in astronomical telescopes, but currently no reliable method of controlling these nanoplates exists. The objective of this experiment is to synthesize silver and gold nano-mirrors and manipulate their orientation using an external magnetic field.

Methods/Materials

Silver and gold nanoplates were synthesized in chemical reduction reactions using silver nitrate as a silver source and chloroauric acid as a gold source. The silver nanoplates were then put through a seeded growth process in order to increase their aspect ratio. The absorbance spectra of the nanoplates were measured and used as indicators of the architecture of the plates. In order to control the orientation of the nanoplates, they were injected into ferrofluid, a solution of iron oxide nanocrystals.

Results

Silver nanoplates were synthesized with spectral peaks ranging from below 400 nm (typically yellow in color) to over 1000 nm (light blue in color), signifying average edge lengths of 20-30 nm. The seeded growth process increased the edge lengths of the silver nanoplates to 2-3 µm while leaving the depth lengths, for the most part, unaffected. The gold nanoplates were synthesized with average edge lengths of 5-6 µm, which was large enough to manipulate without increasing the aspect ratio. Once the silver and gold nanoplates were introduced into ferrofluid, they acted as magnetic holes. This allowed their orientation in the solution to be controlled using an external magnetic field.

Conclusions/Discussion

Due to the large aspect ratio of the nanoplates, the base facets of the nanoplates reflected much more light than the depth facets, giving the nano-mirrors distinguishable "on" and "off" states. Therefore, once the orientation of the nanoplates could be manipulated using an external magnetic field, the nano-mirrors could be turned on and off by controlling which facet of the nanoplates was visible. The ability to control the nano-mirrors with an external magnetic field makes them very useful for applications in astronomical telescopes and adaptive optics.

Summary Statement

Silver and gold nano-mirrors were synthesized in chemical reduction reactions and an external magnetic field was used to control their orientation.

Help Received

Used lab equipment at the University of California at Riverside under the supervision of Dr. Yadong Yin and Qiao Zhang.