Ag NANOPARTICLES PREPARED BY LASER PHOTOREDUCTION AS SUBSTRATES FOR SURFACE-ENHANCED RAMAN SPECTROSCOPY

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The preparation of novel metal nanostructures with advanced properties for Surface-enhanced Vibrational spectroscopies (SEVS, Raman and IR) is a subject of general interest nowadays. Surface-enhanced Raman Scattering (SERS) is a technique which requires the use of metal surfaces fulfilling the surface plasmon resonance (SPR) condition in the region of the laser light employed for Raman excitation [1]. This implies the use of mainly Ag, Au and Cu with a nanostructure morphology [2]. In practice, it is also important the absence on the surface of impurities, since SEVS technique are so sensitive that very low concentrated adsorbates can also be detected [3].

Conventional metal nanostructures employed up to now for SERS are prepared by chemical reduction of Ag^+ with reductors such as citrate or borohydride. The problem of these systems are the chemical products resulting from the reduction and the inherent impurities of these products.

On the other hand, it is of interest developing methods which could allow the in-situ SERS analysis and study of a certain compounds on its natural medium or substrate: a surface, a solution, the air, etc. Moreover, this analysis should not significantly modify the containing substrate in the case, for instance, of the application of SERS to study artistic objects (paints, ceramics, textiles, sculptures, etc.).

For all these reasons, we have recently developed in our laboratory a method to obtain Ag nanostructures by laser irradiacion of Ag^+ by focalizing the laser with a proper objective in a water/solid interfase.

In this work, we show the preliminary results obtained by photoreduction of Ag^+ by changing the following experimental conditions: laser power, exposure time to the laser, Ag^+ concentration and immobilization substrate (neat compound, normal paper, photographic paper and tempera binding medium), and employing the red dye alizarin, with interest for the Cultural Heritage.

References:

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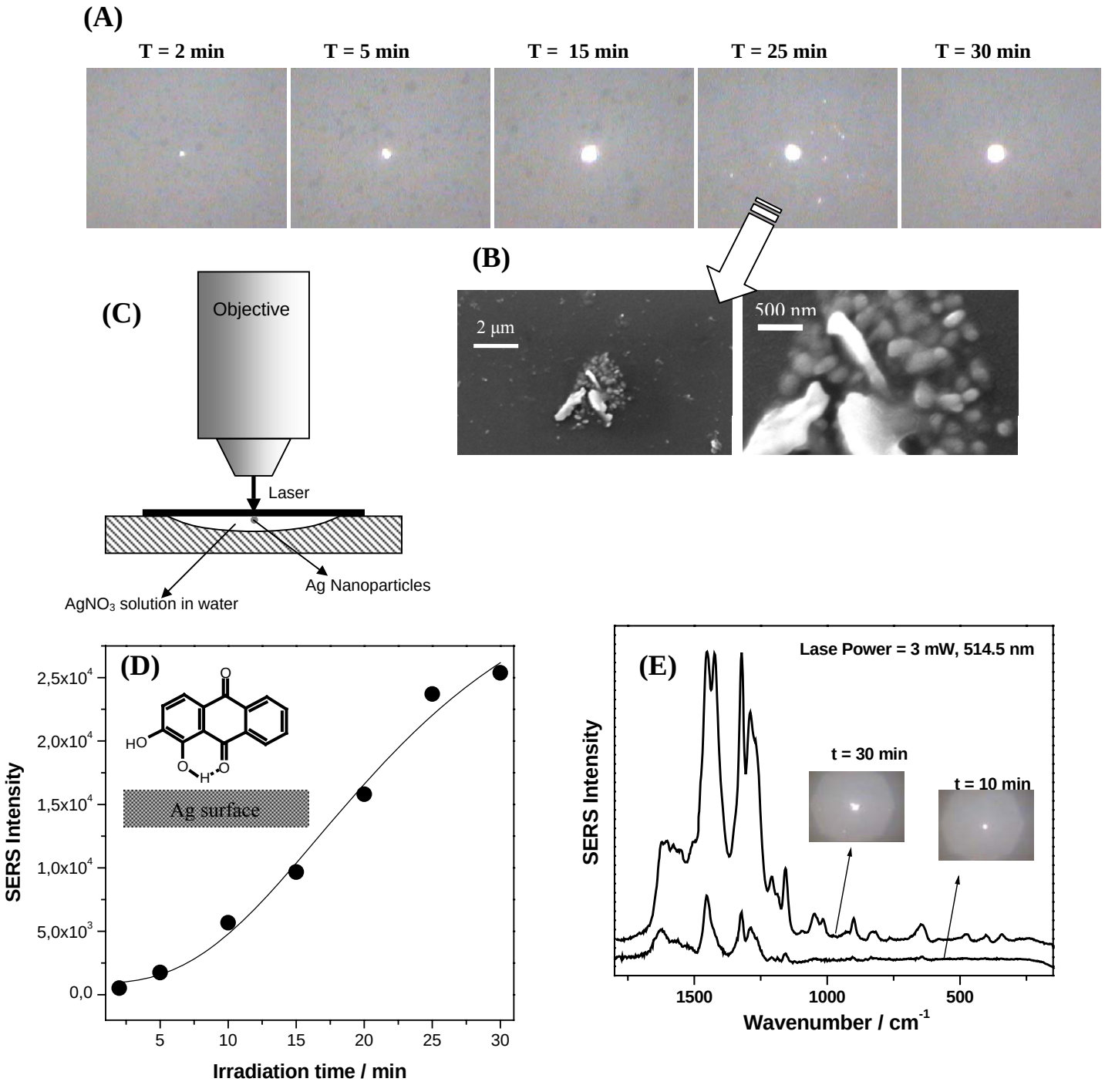
Figures:



(A) Optical images of the photoreduced Ag nanoparticles formed by laser irradiation (514.5 nm) at different times. (B) SEM micrographs of the selected nanoparticles. (C) Scheme of the experimental device employed in the preparation pf the nanoparticles. (D) SERS intensity obtained for the most intense band of the adsorbate alizarin at several irradiation times. (E) SERS spectra of alizarin obtained at two different times.