

# Morphological and structural characterization of Ge nanoparticles produced by Pulsed Laser Deposition

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Pulsed laser deposition (PLD) is a versatile technique to grow high quality multicomponent thin films and nanometer-sized particles (nanoparticles) when a gas atmosphere is introduced in the deposition chamber at low substrate temperatures [1]. In the last years, much effort has been devoted to the production and characterization of Si nanoparticles [1-3], while less works can be found concerning Ge nanoparticles [4-6]. In this regard, Ge material has been proposed as a good alternative to Si for memory device applications due to the smaller band-gap energy that Ge presents [7]. For the development of flash memory devices based on nanoparticles as storage nodes with an optimal performance, it would be highly desirable to control the nanoparticles size and density distribution while avoiding the micron-sized particles deposition on the substrate surface, usually obtained in the ablation process.

In this work, we have systematically studied the morphological and structural properties for Ge nanoparticles (NPs) obtained by Pulsed Laser Deposition (PLD) on Si (100) substrates in an Ar environment at room temperature (RT). In our experimental setup, we have used a KrF excimer laser ( $\lambda = 248$  nm,  $t_p = 10$ ns). We demonstrate that it is possible to control the nanoparticles distribution by controlling the experimental deposition conditions. We also demonstrate that both the occurrence of micron-sized particulates on the surface and uniformity in the nanoparticles size distribution can be controlled by introducing a mechanical filter (solid disk) between the target and the substrate. We have also evaluated the crystallinity of the produced nanoparticles at RT.

The size distribution and dispersion of the obtained Ge nanoparticles were evaluated using Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The structural properties of the nanoparticles were characterized by X-ray diffraction and Raman Spectroscopy.

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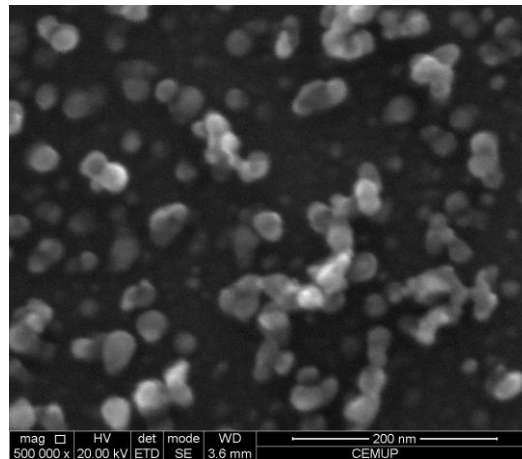


Figure 1: SEM image of Ge nanoparticles produced by Pulsed Laser Deposition at room temperature.