GE ON SI NANOSTRUCTURES DEPOSITED BY PLD

Daria Riabinina[1], Federico Rosei, Mohamed Chaker
INRS-EMT, Université du Québec, 1650 Blvd. Lionel-Boulet, C.P.1020, Varennes, Québec J3X 1S2, Canada
E-mail : riabinina@inrs-emt.uquebec.ca

Semiconductor nanostructures are of great interest because of their numerous potential applications. Indeed, quantum dots (QD) as the active gain medium in semiconductor lasers may be one of the early applications of nanotechnology within active devices of commercial use. Ge on Si nanostructures is the key system for the integration and development of optoelectronic devices in the existing silicon-based industry [1, 2].

Pulsed laser deposition (PLD) has established itself as a very versatile method for thin film growth of almost any kind of materials. During PLD, the interaction between an intense laser and a target material results in the creation of a plasma that contains several species including neutrals, ions, electrons and small clusters. This plasma is highly directional and allows the transfer of matter from the target to the substrate. It is known that highly nanocrystalline and cluster-assembled films can be prepared by single beam PLD when deposition is performed into a moderate pressure gas [3]. Recent studied were performed on the size of Si nanoclusters deposited by PLD [4, 5]. The size of the deposited nanostructures can be controlled by tuning the deposition conditions.

In this work, we study the size correlation of Ge nanoclusters with the deposition conditions such as gas pressure, target-substrate distance and laser fluence. Characterization of the surface morphology was performed by *ex situ* atomic force microscopy (AFM). The pressure of inert gas (He) was varied from 1 to 10 Torr. For an increase of He pressure it was observed that size of nanoclusters decreases (Figure 1). Decreasing the laser fluence from 5 J/cm^2 to 0.5 J/cm^2 resulted in decrease in the size of Ge nanoparticles. The growth process of Ge nanoparticles on a Si substrate was also a subject of considerable interest of this study.

The size-controlled growth of semiconductors nanostructures at room temperature is a major advantage of PLD technique. Usually semiconductors nanostructures are grown by molecular beam epitaxy or chemical vapour deposition. The major problem of these techniques is the limited control of the size and shape of zero-dimensional nanostructures. PLD is an alternative technique of the growth of semiconductors nanostructures with a good control of their size distribution.

[1] Presenting author

Figures:

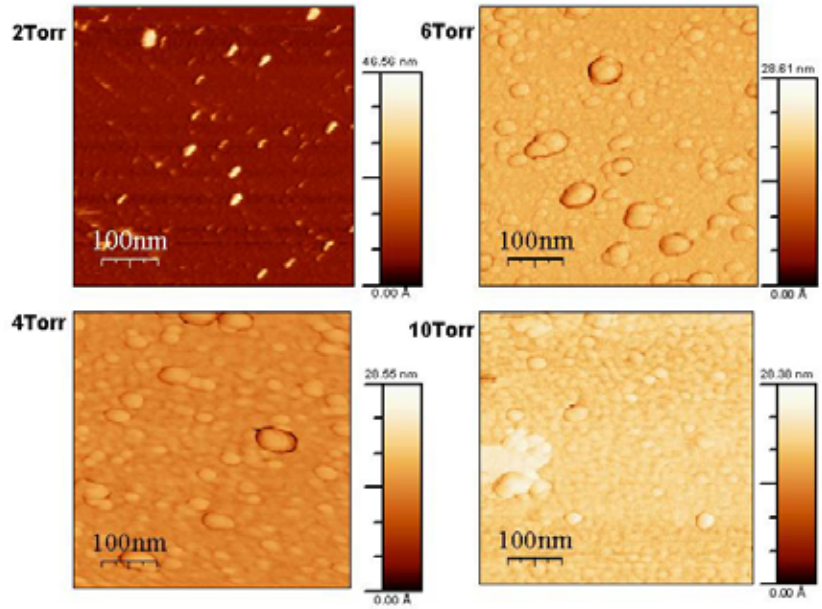

Figure 1. AFM image of surface morphology of the sample as a function of the gas pressure (2Torr, 4Torr, 6Torr, 10Torr). Fluence 2.2J/cm^2, target-substrate distance 50mm.

References:

[1] N. Motta, J. Phys. : Cond. Matt. **14** (2002) 8353.
[2] F. Rosei, J. Phys.: Cond. Matt. **14** (2004) S1373.
[3] D.H. Loendes, D.B. Geohegan, A.A. Puretsky, D.P. Norton, C.M. Rouleau, Science **273** (1996) 898.
[4] L. Patrone, D. Nelson, V.I. Safarov, M. Sentis, W. Marine, J. Appl. Phys. **87** (2000) 3829.
[5] A.V. Kabashin, J.-P. Sylvestre, S. Patskovsky, M. Meunier, J. Appl. Phys. **91** (2002) 3248.