18. - 21. May 2015 Darmstadt, Germany

Contribution ID: **101** Type: **Oral**

Ion-shaped Metallic Nanoparticles: Fundamental Aspects and Applications

Tuesday, 19 May 2015 17:40 (20 minutes)

In the last years, ion-shaping technique has been proposed as an innovative and powerful tool to manipulate matter at the nanometer scale. Deformation can be indirectly induced by embedding metallic NPs into an ion-deformable amorphous host matrix. With this technique, it is possible to transform nanospheres into nanorods, nanowires, facetted nanoparticles, or other original shapes. The aspect ratio and spatial orientation of these NPs can be tuned by varying the irradiation conditions (ion, ion-energy, irradiation angle, fluence).
To understand the mechanisms of deformation, the evolution of the temperature profile during the ion impact within the nanoparticle is simulated by implementing the thermal-spike model for three-dimensional anisotropic and composite media. By this way, a straight correlation is found between the fraction of the nanoparticle that is molten (vaporized) and the deformation path followed by the nanoparticles during the irradiation. This allows to relate the initial nanoparticle to its final morphology, in order to generalize the ion-beam shaping process for all the nanoparticle shapes and dimensions.
Besides the fundamental aspects related to the ion-matter interaction, ion-shaping can also be used to give new insights into the plasmonic properties of metallic nanoparticles. Here, Electron Energy Loss Spectroscopy (EELS) is used to study Localized Surface Plasmon Resonances (LPSR) in ion-shaped metallic nanoparticles with a nanometer-scale spatial resolution. LSPR are generated through electron excitation is a Scanning Transmission Electron Microscope (STEM), equipped with a High Angle Annular Dark Field (HAADF) detector. These experimental results are simulated using a specifically developed Auxiliary Differential Equations-Finite Difference Time Domain (ADE-FTDT) code and the Metallic NanoParticles Boundary Element Method (MNPBEM) code.

Primary author: Dr COULON, Pierre-Eugene (Laboratoire des Solides Irradies, Ecole Polytechnique, 91128 Palaiseau, France)

Co-authors: Dr FAFIN, Alexandre (Centre de Recherche sur les Ions, les Materiaux et la Photonique, 14070 Caen, France); Dr LOSQUIN, Arthur (Laboratoire de Physique des Solides, Université Paris Sud XI, 91405 Orsay, France); Dr DUFOUR, Christian (Centre de Recherche sur les Ions, les Materiaux et la Photonique, 14070 Caen, France); Dr ULYSSE, Christian (Laboratoire de Photonique et de Nanostructures, 91460 Marcoussis, France); Dr MAILLY, Dominique (Laboratoire de Photonique et de Nanostructures, 91460 Marcoussis, France); Dr RIZZA, Giancarlo (Laboratoire des Solides Irradies, Ecole Polytechnique, 91128 Palaiseau, France); Dr MONNET, Isabelle (Centre de Recherche sur les Ions, les Materiaux et la Photonique, 14070 Caen, France); Dr CARDIN, Julien (Centre de Recherche sur les Ions, les Materiaux et la Photonique, 14070 Caen, France); Dr KOBYLKO, Mathias (Laboratoire des Solides Irradies, Ecole Polytechnique, 91128 Palaiseau, France); Dr KOCIAK, Mathieu (Laboratoire de Physique des Solides, Université Paris Sud XI, 91405 Orsay, France); Dr PERRRUCHAS, Sandrine (Laboratoire de Physique de la Matiere Condensee, Ecole Polytechnique, 91128 Palaiseau, France); Dr GACOIN, Thierry (Laboratoire de Physique de la Matiere Condensee, Ecole Polytechnique, 91128 Palaiseau, France); Dr KHOMENKOV, Vladimir (Centre de Recherche sur les Ions, les Materiaux et la Photonique, 14070 Caen, France); Dr LAFOSSE, Xavier (Laboratoire de Photonique et de Nanostructures, 91460 Marcoussis, France)

Presenter: Dr COULON, Pierre-Eugene (Laboratoire des Solides Irradies, Ecole Polytechnique, 91128 Palaiseau, France)

Session Classification: Session 7

Track Classification: 06 - Optical properties of insulators