High density of electronic excitation in nanometric scale: transformation of the matter.

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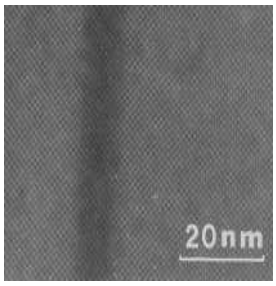
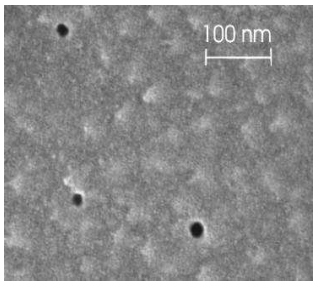
Within the several possibilities of producing high electronic excitation, swift heavy ions allow to create a high electronic density in nanometer scale. The energy deposited on the electrons along the ion path comes down to the lattice and transform the matter in a cylinder of around 10 nm in diameter (figure on left)

After a review of selected experimental results concerning insulating materials, a transient thermal process will be developed to quantify the track size. In this model, the energy given to the electrons relaxes to the lattice atoms via the electron-phonon interaction. When considering the input parameters in this model, the main one will be the electron-phonon mean free path that defines the length of energy that diffuses on the electrons prior its transfer to the lattice and the energies necessary to reach phase transformation. This model could be applied to any material subject to irradiation with swift heavy ions (space components, nuclear fuel, nuclear waste, biological material and cancer therapy) and also used to pattern material at a nanometric scale (figure on right).



Amorphous track in $Y_3Fe_5O_{12}$



Hole in a resist deposited on silicon after irradiation and etching.