# FABRICATION OF NOVEL NANOSTRUCTURED OPTICAL MEDIA BY SWIFT HEAVY ION IRRADIATION

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The use of high-energy heavy ion irradiation to create or modify nanostructured and nanocomposite materials is receiving increasing attention. Above a certain sharp threshold in the electronic excitation induced by swift heavy ions, an amorphous latent nanotrack (with a few nanometer diameter) is generated in crystalline materials [1,2]. Spherical metallic nanoparticles, of great interest in nanophotonics, become elongated under swift on irradiation showing very large and usefull plasmon resonance frequency shifts [3]. The amorphous nanotracks can be chemically etched away fabricating in this way unique very long nanopores, which can be further filled with metals and semiconductors.

In this work first we describe how the process of amorphous nano-track formation is exploited to generate optical waveguides by ion irradiation in the materials $LiNbO_3$ and KGW. The method relies on choosing the ion and its energy so as to have the maximum of the electronic stopping power, $S_e(z)$, a few microns inside the crystal (as shown in Fig 1) and reaching a value above the threshold for latent track formation ($S_{e,th} \approx 5$ keV/nm), while the stopping power is below the threshold at the surface [4]. Irradiation in the single track regime with fluences of the order of $10^{12}$ at/cm$^{-2}$ is enough to generate a buried modified layer, actually a nanoestructured system, which effective refractive index decreases relative to the virgin crystal providing the waveguide confinament. The fluences used are several order of magnitude lower than the state of the art. The propagation losses after suitable annealing is of the order of 1 dB/cm. The use of different ions and energies (Si 20-45 MeV, Cl 45MeV, Mg 39 MeV) also reveals the influence of the so called velocity effect. Precisely the optical waveguide characterization can give valuable information on this not yet well understood phenomenom.

Chemical etching of the amorphous nanotracks to generate nanopores has been studied by AFM Fig 2. Nanopores develope an anysotropic shape related to the crystallographic axis of the sample.

**References:**

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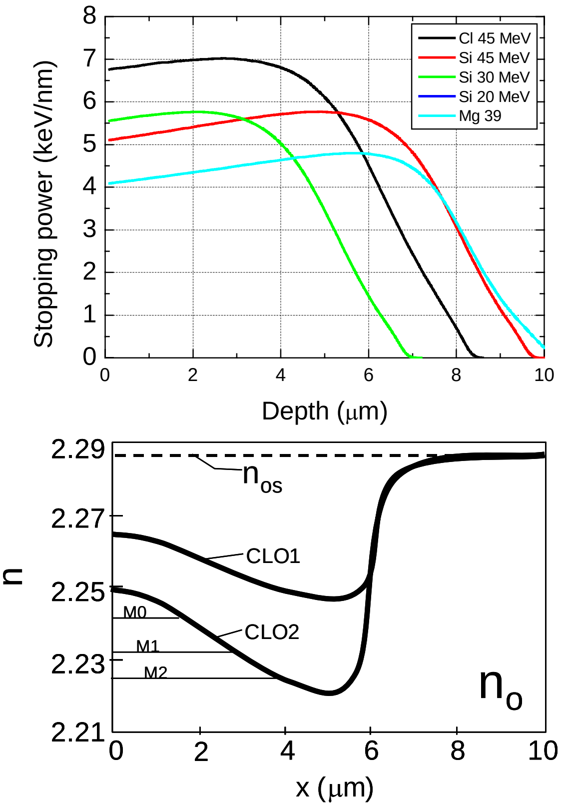


**Figure 1:** Electronic stopping power of several swift ions in $LiNbO_3$, and refractive index profile induced for the case of clorine ion irradiation

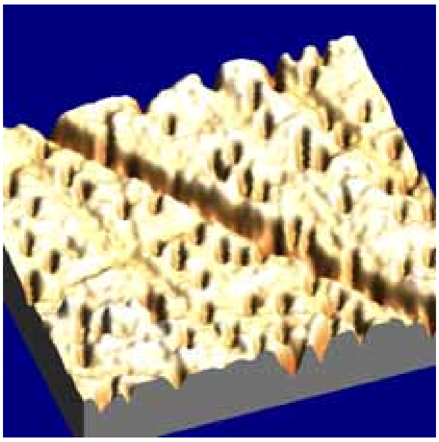

**Figure 2:** Oriented nanopores fabricated in LiNbO3 by etching away the amorphous nanotracks induced with swift ion irradiation (Cu 50 MeV); The window size is (680 x 570) nm.