# FABRICATION OF NANO-STRUCTURED OPTICAL WAVEGUIDES BY ION TRACK TECHNOLOGY

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Optical waveguides are key elements for many present and future photonics devices. The high optical confinement that they provide makes that optical non-linear processes become very efficient. Ion implantation of light ions has been used intensively for many years for fabrication of optical waveguides in many materials of photonic interest. However the doses needed, of the order of $10^{16}$ at/cm$^2$, strongly hinders the practical usefulness of the method.

On the other hand latent (amorphous) tracks produced by ion irradiation of various type of crystalline sustrates performed with medium and high mass ions is receiveing increasing attention. For each material there exist a threshold for the electronic stopping power above which the ion creates an amorphous track along the ion track. The track diameter increases with the stopping power and is in the range of a few nanometers, while the length of the track is several microns. The amorphous tracks can be later on easily etched away creating nanopores of high aspect ratio. These irradiation-etching process has also been applied to glasses and polymers to succesfully create nanopores templates. Filling the nanopores with various magnetic metals is one of the very promising applications being developped.

We have proposed and demonstrated the usefulness of the latent ion tracks to produce optical waveguides in a new approach (see Fig. 1 for schematic presentation). By carefull selection of the stopping power curve in depth it is possible to induce the máximum refractive index change inside the crystal and therefore create optical waveguides. The doses needed are in the single track regime, that is, of the order of $10^{12}$ at/cm$^2$, what is an improvement of at least a factor 100 compared with the production of optical waveguides with the standard implantation concept.

Moreover the tracks can be etched away giving rise to a structure comprising simultaneously the optical waveguide and a nanopore structure that can allow the introduction of gas molecules. This is very promissing for waveguides sensors.

**References:**

[1] B. Canut and S. M. M. Ramos, Radiation Effects&Defects in Solids 145, 1, (1998)

**Figures 1**

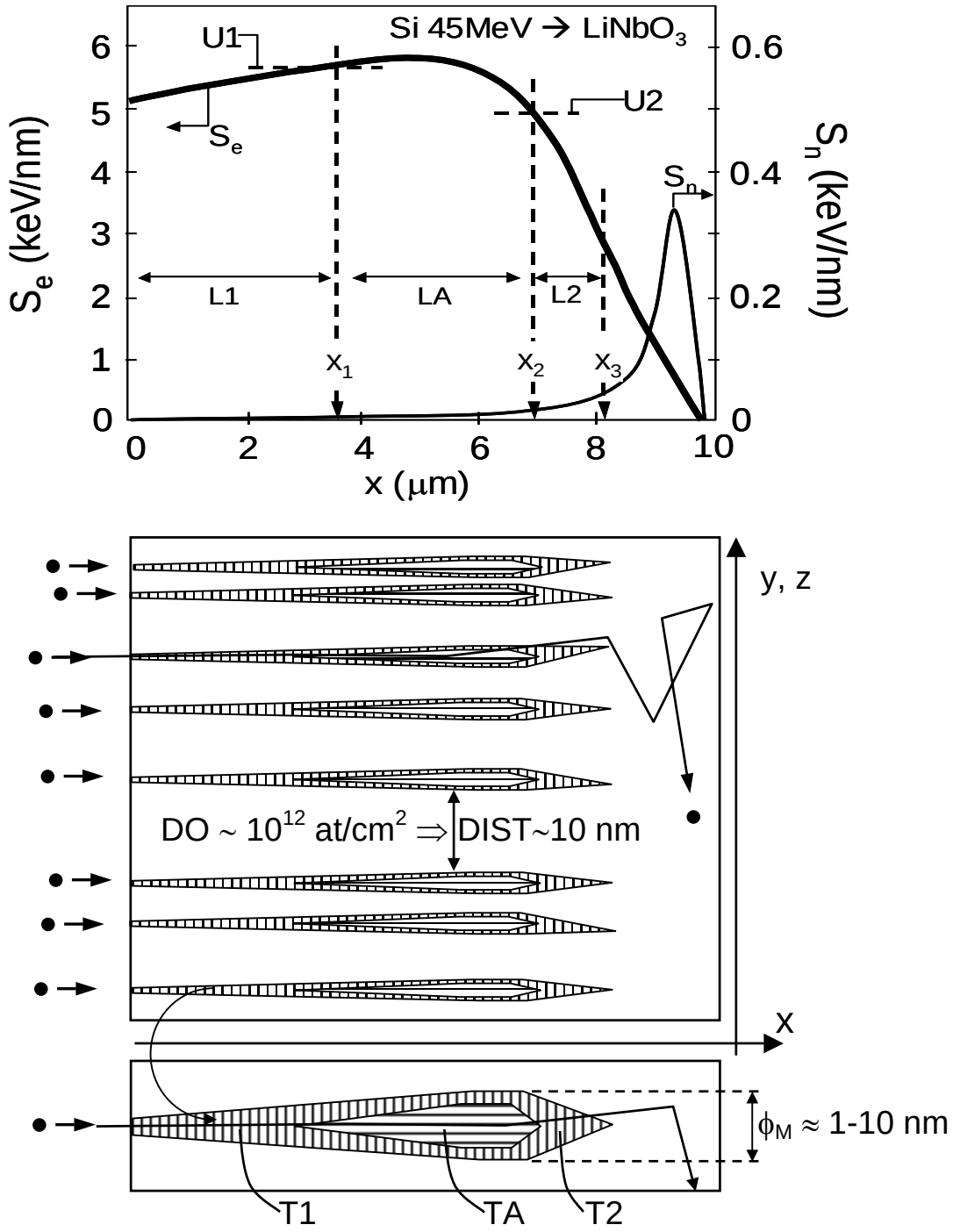


Figure 1