Thick optical waveguides in lithium niobate induced by swift heavy ions (~10 MeV/amu) at ultralow fluences

Olivares J, Crespillo ML, Caballero-Calero O, Ynsa MD, García-Cabañes A, Toulemonde M, Trautmann C, Agulló-López F
OPTICS EXPRESS Vol. 17, No. 26 (21 December 2009) 24175-24182

Heavy mass ions, Kr and Xe, having energies in the ~10 MeV/amu range have been used to produce thick planar optical waveguides at the surface of lithium niobate ($LiNbO_3$). The waveguides have a thickness of 40-50 micrometers, depending on ion energy and fluence, smooth profiles and refractive index jumps up to 0.04 (λ = 633 nm). They propagate ordinary and extraordinary modes with low losses keeping a high nonlinear optical response (SHG) that makes them useful for many applications. Complementary RBS/C data provide consistent values for the partial amorphization and refractive index change at the surface. The proposed method is based on ion-induced damage caused by electronic excitation and essentially differs from the usual implantation technique using light ions (H and He) of MeV energies. It implies the generation of a buried low-index layer (acting as optical barrier), made up of amorphous nanotracks embedded into the crystalline lithium niobate crystal. An effective dielectric medium approach is developed to describe the index profiles of the waveguides. This first test demonstration could be extended to other crystalline materials and could be of great usefulness for midinfrared applications.