Experimental observation of intrinsic localized modes in germanium

J.F.R. Archilla[1,*], S.M.M. Coelho[2], F.D. Auret[2], V.I. Dubinko[3] and V. Hizhnyakov[4]

[1] *Group of Nonlinear Physics, Universidad de Sevilla, Avda Reina Mercedes s/n, 41012-Sevilla, Spain*
[2]*Department of Physics, University of Pretoria, Lynnwood Road, Pretoria 0002, South Africa*
[3]*NSC Kharkov Institute of Physics and Technology, Kharkov 61108, Ukraine*
[4]*Institute of Physics, University of Tartu, Ravila 14c, 50411, Tartu, Estonia*
* *archilla@us.es*

We have found experimentally that very low energy (2-8eV) argon plasma when acting on a germanium wafer is able to modify or anneal defects at least two microns below the surface. The plasma has a very low flux so each Ar impact is practically isolated in time and space, meaning that it is not possible the formation of a wavefront or shockwave . The sample is kept at approximately room temperature, therefore excluding thermal annealing. There is very little diminution of the rate of annealing with depth, which implies that the perturbation does not spread and keep most of its energy while travelling. The annealing energies of the defects studied are about 1 eV. The conclusion is that localized energy produced by Ar impacts is able to travel long distances through the semiconductor [1]. The most probable cause is vibrational energy in the form of intrinsic localized modes (ILMs). Stationary ILMs have been found in Ge but not yet mobile ones [2].

1. J.F.R. Archilla, S.M.M. Coelho, F.D. Auret, V.I. Dubinko and V. Hizhyakov, "Long range annealing of defects in germanium by low energy plasma ions?", *Physica D* **297**, 56–61 (2015).
2. V. Hizhnyakov, M. Haas, A. Shelkan, M. Klopov, "Standing and moving discrete breathers with frequencies above phonon spectrum", in “Quodons in Mica: nonlinear localized travelling excitations in crystals”, Springer, New York (2015), to appear.