Destructive Metallic Nanoclusterizaion in Oxide and Chalcogenide Glassy Media

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Plasmonic nanocomposite materials like glasses containing metallic nanoparticles (NPs) are of high practical importance in view of their excellent nonlinear optical properties such as increased high-order nonlinearities [1]. Ion implantation (***highly destructive*** method) is one the widely used methods to ensure agglomeration of *guest* NPs in *host* glassy matrix. The degree of destruction being strongly dependent on the atomic compactness [2]. In relatively dense matrices, which are proper for glassy oxides containing great amount of silica SiO_2 [2] or chalcogenide glasses (ChGs) of mixed Ge/As-S/Se systems [3], the intrinsic interatomic linking of a glass structure should be significantly destroyed to accommodate the embedded NPs. In such case, agglomeration occurs under tight chemical interaction between NPs and destructed glass components, the preferential character of this interaction being decisive in the finalized properties of NPs-embedded glassy system. So principal difference between oxide- and chalcogenide-type glassy matrices should be examined quantitatively to clarify possible consequences resulting from expected diversity in the destructive clustering for the embedded NPs. In this work, it was tried to accomplish this from point of mean bond energies.

The principal difference in the origin of optical nonlinearities caused by metallic NPs (Cu, Ag, Au) embedded destructively in oxide- and chalcogenide glasses was shown. The energetic barriers of bond disproportionality for implanted atoms occur to be different for oxide and chalcogenide environment. This finding is in full agreement with numerous evidences exploring destructive and non-destructive mechanisms of NPs embedding.

[1] A. Zakery and S.R. Elliott, *Optical nonlinearities in chalco-genide glasses and their applications*, Springer-Verlag, Berlin-Heidelberg, 2007.

[2] A.L. Stepanov, *Ion-synthesis of metal nanoparticles and their optical properties*, Nova Sci. Publ., New York, 2011.

[3] A. Feltz, *Amorphous inorganic materials and glasses*, VCH Publ., New York, 1993.