Control of metastable state of glass

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Abstract

Glass is a special material featuring good homogeneity, variable composition, easy shaping and doping, owing to its meta-stable state and topological network structure. It is considered that the nature of glass and glass transition are among the most important problems in the field of condensed matter. However, no dramatic change of the glass properties can be realized by controlling fictive temperature of glass. We focus our research on the change and enhancement of the properties of glass by manipulation of the metastable nature of glasses. This strategy allows for precise control of the microstructure of glasses by using external fields e.g. light, temperature and pressure, and the development of novel and enhanced functionalities by controlling electronic band structure, defect state and nano- or microstructure of glass. In this talk, I will highlight our recent research developments on the design and control of the optical properties of glass through fast-cooling, crystallization and phase separation. We have demonstrated the realization of ultra-broadband near-infrared emission via control of valence state of Bi ion, ligand field around transition metal ions and energy transfer between two active ions for broadband optical amplification and tunable laser. I will also introduce our recent results on the printing of three-dimensional nano- or microstructures and multiple functions inside glasses by fs laser based on multiphoton absorption assisted control of excited state of dopants and nanostructures. These studies are not only helpful for understanding the nature of glass, but also valuable for the fabrication of optical devices.

Keywords: glass, metastable state, crystallization, laser

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