Novel method for fast synthesis of advanced superconducting and magnetic materials

A. Shengelaya, D. Daraselia, D. Japaridze, Z. Jibuti

E-mail: alexander.shengelaya@tsu.ge

Department of Physics, Tbilisi State University, GE-0128, Tbilisi, Georgia

High-temperature superconductors (HTS) and other technologically important oxide materials are usually obtained through solid state reaction. This implies long-term (for tens of hours) heating of reactants in powder form at high temperatures (800º-1200ºC) in furnace, which is a highly time and energy consuming process and increases product costs. Moreover, the long-term high temperature synthesis may result in deviation from stoichiometry as well as in enlargement of the ceramic grain sizes. Therefore there is a significant worldwide effort to develop technologies to considerably reduce the solid state reaction temperature and time.

During the last three years a new technology was discovered and developed by our group at Tbilisi State University (TSU) for fast synthesis of superconducting and magnetic oxide materials, which we called Photostimulated Solid State Reaction (PSSR) [1]. The essence of the PSSR is the irradiation of the mixture of starting oxides by light in a broad spectral range from infrared to ultraviolet with intensity sufficient for starting the solid state reaction between the reagents contained in the powder mixture. We have shown that the rate of the resulting reaction exceeds the conventional thermal solid state reaction rate in furnace by about two orders of magnitude. This allows synthesis of advanced superconducting and magnetic materials within seconds instead of several hours.

The novel PSSR technology developed in TSU and corresponding equipment have a very broad application since most of the advanced ceramic materials like strong permanent magnets, solid fuel cells, solar cells and catalizators are produced by solid state reaction in high temperatures furnaces. Therefore the preparation of these materials using PSSR can significantly reduce the synthesis time and costs, which is crucial for applications.

References

[1] D. Daraselia, D. Japaridze, Z. Jibuti, A. Shengelaya and K. A. Müller, J. Supercond. Nov. Magn., **26**, 2987 (2013).