Electronic Structure, Optical and Dielectric Spectroscopy of $TbMnO_3$ Multiferroic

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Remarkable family of orthorhombically distorted perovskite-like rare earth manganites *R*MnO_3 (R = La, Pr, Nd, Sm, Eu, Gd, Tb, Dy) has been attracting a plenty of attention exhibiting new diverse properties, of high fundamental academic and application interests (e.g. colossal magnetoresistance). Among of them, magnetoelectric multiferroics (or ferroelectromagnets) manganites with R = Eu, Gd, Tb, Dy are turned out to be the objects of the peculiar interest now. At room temperature they are paramagnetic ones. In the temperature region of T < 30- 40 K they obey magnetic ordering followed by induced long order ferroelectric phase transitions. Close proximity of ferroelectric and magnetic phase transitions provides strong coupling magnetic and ferroelectric degree of freedom, intricate interplay of the lattice, charge, orbital, and spin, emergence of unique properties and effective magnetic control of a spontaneous polarization. In this regard, orthorhombic $TbMnO_3$ has attracted a special considerable attention. Namely studies this material led to discovery of a new class of multiferroics with spin-spiral driven ferroelectricity (new mechanism of ferroelectricity), and efficient switching phenomena. In this report we present recent results of spectral ellipsometry, thermooptics, luminescence, and low-frequency dielectric permittivity studies of $TbMnO_3$ single crystals. The main attentions was paid to determination of electronic structure, elucidation of the nature of main optical transitions, phase transitions related properties, obtaining experimental evidences of electronic contribution in ferroelectric phase transitions of $TbMnO_3$ and nature of an unusual dielectric dispersion was found in the region of ferroelectric phase transition. It was shown that observed dispersion is caused by pronounced magneto-electric coupling.