

ANOMALOUS PROPERTIES OF RARE EARTH DOUBLE TUNGSTATES

M.T.Borowiec¹, T.Zayarnyk¹, A.Szewczyk¹, V.P.Dyakonov^{1,3}, A.Majchrowski²,
H.Szymczak¹

¹Institute of Physics, Polish Academy of Sciences, Warsaw, Poland

²Institute of Applied Physics, Military University of Technology, Warsaw, Poland

³A.A.Galkin Donetsk Physico-Technical Institute, National Academy of Sciences, Ukraine

The rare-earth double tungstates $ARe(WO_4)_2$ ($A = K, Rb$, $Re = Er, Ho$) [1-3] are attractive materials from scientific point of view. The special scientific interest is connected with possible realization of both magnetic and structural phase transitions in them. The single crystals were grown with use of the Top Seeded Solution Growth (TSSG) technique. The materials crystallize in α - $KY(WO_4)_2$ structure with $C_{2h}^6(C2/c)$ symmetry.

The specific heat, specific heat in magnetic field, optical absorption and optical absorption in magnetic field (Zeemann effect) were measured. The magnetic properties of holmium and erbium double tungstates were investigated. Measurements of a specific heat were carried out in a wide interval of temperatures and magnetic fields (up to 9T). The optical absorption measurements were realized in a broad spectral (6000cm^{-1} - 40000cm^{-1}) and temperature range (1.1K-300K). The magneto-optical investigations for potassium erbium double tungstate were carried out for the magnetic field up to 7T.

The anomalies of the specific heat and optical absorption at 5.5K for potassium holmium double tungstate were found. The anomalies of the Zeeman effect (non-typical behavior of optical absorption under magnetic field) were observed for the magnetic field bigger than 5T for potassium erbium double tungstate.

The observed anomalies for potassium holmium double tungstate were explained as due to the spontaneous structural phase transition caused by the cooperative Jahn-Teller effect (CJTE). The anomalous behaviour of potassium erbium double tungstate under magnetic field was described as due to the induced structural phase transition of the CJTE type. The conditions for the spontaneous and induced structural phase transitions for holmium and erbium double tungstates were discussed.

[1].T.Zayarnyk, MT.Borowiec, V.P.Dyakonov, H.Szymczak, E.Zubov, A.Pavlyuk, M.Barański “*Optical properties of potassium erbium double tungstate $KEr(WO_4)_2$* ”, **Proc.SPIE** 4412, 280-285, 2001

[2] M.T.Borowiec, Y.M.Kharchenko, T.Zayarnyk, V.P.Dyakonov, M.Barański, H.Szymczak, “*Optical properties and Zeeman effect in potassium erbium double tungstate*”, **J.Applied Spectroscopy** 71, 2004, in print

[3] M.T.Borowiec, A.Watterich, T.Zayarnyk, V.P.Dyakonov, A.Majchrowski, J.Żmija, M.Barański, H.Szymczak, “*Optical spectroscopy of $KHo(WO_4)_2$ and $KEr(WO_4)_2$ single crystals*”, **J.Applied Spectroscopy** 71, 2004, in print