Electrical transport properties of $Yb_{8-x}Y_xV_2O_{17}$ (x=0, 2, 8)

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Preliminary studies of the ternary oxides V_2O_5–Yb_2O_3–Y_2O_3 system have shown that, in one of its sections, *i.e.* in the system $Yb_8V_2O_{17}$–$Y_8V_2O_{17}$, a previously unknown phase of the formula $Yb_6Y_2V_2O_{17}$ is formed [1]. The new phase $Yb_6Y_2V_2O_{17}$ was obtained by heating a mixture of the three oxides, *i.e.* Yb_2O_3, V_2O_5 and Y_2O_3 in a molar ratio (3:1:1) in air, between temperatures 873–1823 K [1]. The X-ray powder diffractogram showed that $Yb_6Y_2V_2O_{17}$ is isostructural with $Yb_8V_2O_{17}$ and crystallizes in the triclinic systems [2]. According to the results of our research the elementary cell parameters of $Yb_8V_2O_{17}$ (x=0) which refined with the use of the program REFINEMENT are as follows: a=0.8932 nm, b=0.9259 nm, c=0.9794 nm, α=77.684°, β=106.367°, γ=116.348° [2]. This result is contrary to the literature data [3].

In the present study the electrical and optical properties of $Yb_{8-x}Y_xV_2O_{17}$ for x=0 and 8 [2–4] as well as for a new phase (x=2) were carried out. Ultraviolet–visible and near-infrared (UV–vis–NIR) diffuse reflectance spectra were recorded at room temperature and in the wavelength range of 200–900 nm using a JASCO-V670 spectrophotometer equipped with an integrating sphere. The electrical conductivity, $\sigma(T)$, and the *I-V* characteristics have been measured with the aid of the DC method in the temperature range 300–400 K using a KEITHLEY 6517B Electrometer/High Resistance Meter. The thermoelectric power, *S(T)*, was measured in the temperature range 300–600 K with the aid of a Seebeck Effect Measurement System (MMR Technologies, Inc., USA).

The UV-vis-NIR measurements have shown that all phases of $Yb_{8-x}Y_xV_2O_{17}$ are insulators for the energy gap of 2.6 eV for x=2, whose value is comparable to that of other samples (x = 0 and 8). The phases under study showed low electrical conductivity, σ(T), that decreased with increasing content of ytterbium and had a characteristic minimum shifting to higher temperatures from 322, via 360 to 370 K in the sequence x=0, 2 and 8, respectively. The thermoelectric power, *S(T)*, increased with the increase of the ytterbium content and showed *n-p* transition at 410 and 467 K for x=0 and 2, respectively. For x=8 *n*-type electrical conductivity was observed probably due to predominant contribution of oxygen vacancies. The most interesting observation concerns the non-linear *I-V* characteristics for all the compounds under study, similar to back-to-back Zener diodes. A breakdown voltage V_b ~26 V/mm was mainly observed for the *I-V* characteristics at 400 K and it was almost twice lower than the value of V_b at 300 K, showing a varistor-like behavior. The studied materials can be used as the voltage stabilizers, the electronic power systems and the transient surge suppression in electronic circuits.

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