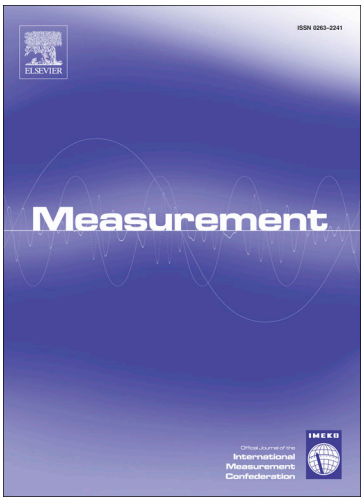

Polaronic transport in antimony-vanadium tellurate glasses at high temperatures

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Polaronic transport in antimony-vanadium tellurate glasses at high temperatures

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Abstract

The ternary bulk glasses of the form $(60-x)V_2O_5$- $40TeO_2$-xSb with $0 \leq x \leq 15$ (in mol%) were prepared by using the standard melt quenching technique. The dc electrical conductivity of the mentioned samples was investigated within the temperature range of 296 - 408 K. The dc conductivities at 370 K, with values in the range of 4.80×10^{-6}- 1.08×10^{-4} Scm $^{-1}$, were found to decrease with increase of Sb content. The experimental temperature- dependency of conductivity and the variation of the pre-exponential factor were interpreted in terms of polaron hopping theory. It founds that within the studied temperature range, the non-adiabatic small polaron hopping (NASPH) mechanism for electrons between different valent states of vanadium ions is applicable. The ratio of wave function decay (tunneling factor α) was found to be 2.26×10^{8} cm^{-1} for samples with x≥8 mol%.

Keywords: amorphous semiconductorsdc electrical conductivity, small polaron hopping (SPH), oxide glasses, tellurate glasses.

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1. Introduction

Electrical conduction of glasses containing transition metal oxides (TMO) are of great interest due to their semiconducting nature which arises from the presence of TM ions in multivalent states. The polaronic model of electrical conduction is generally applicable to transition metal oxide glasses and conduction occurs by the small polaron hopping (SPH) between two different valent states of TM ions [1-19]. Furthermore, tellurate glasses are of technical importance because of their high refractive index, high glass forming ability, low and accessible melting point and also no hygroscopic property (high durability) which limits the application of phosphate glasses [20, 21]. Generally, at the temperatures $T \rangle \Theta_D / 2$ (T is the absolute temperature and Θ_D is the Debye temperature), the dc electrical conduction was now well understood to occurs by small polaron hopping (SPH) based on a strong electron-lattice coupling [3,5-10,14-15].

Based on the previously reports, there are some papers on the electrical properties of vanadate-tellurate glasses of the form V_2O_5- TeO_2-A_mO_n (or A) (which, A_mO_n or A are another oxide or element as the third component, respectively) [1,