The Anodic and Cathodic Voltamperometry of Glasses of System Tl-As-Se-Te

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It is necessary to dilate a circle of research techniques of semiconductor glasses for their application in making new technological materials. We have applied for the first time method of paste technology with use of organic binding agents to study glassy semiconductors. We managed to pick up requirements for removal of voltamperograms of the chalcogenide glasses with the help of an coal paste electrode in feeble and strongly alkaline mediums. The most systematic examination was carried out in a feeble-alkaline condition. The 0.3 m.. solution Na_2HPO_4 was utillized as background electrolyte.

The experimental data on paste-like anodic voltamperometry at change of a polarizing voltage from 0, -0.5, -1, -1.5, -2 up to +2 V and cathodic voltamperometry in an interval of polarizing voltages from +2 up to -2 V for glasses of system Tl-As-Se-Te are received. The velocity of scan of a polarizing voltage in phosphatic background electrolyte is given 0.4 V in minute. The polarizing voltage was set concerning potential of a calomel reference electrode. It is supposed, that the analytical information is fixed about an explored material or is still padding about products of beforehand reduction or accordingly oxidization of particles of a glass in paste depending on the limits of a polarizing voltage at removal of anodic and cathodic voltamperograms.

The glasses of the following sections are chosen in system Tl-As-Se-Te for examination 1) AsSe-Tl, 2) AsSe-TlSe, 3) As_2Se_3–Tl, 4) As_2Se_3–Tl_2Se, 5) $TlAsSe_2$–$TlAsTe_2$. Is shown, that with the help of coal paste-like the technologies can be revealed electrochemical activity of the chalcogenide glasses with high electrical

resistance. The structural - responsive information on peaks of a current for glasses of system Tl-As-Se-Te is received.

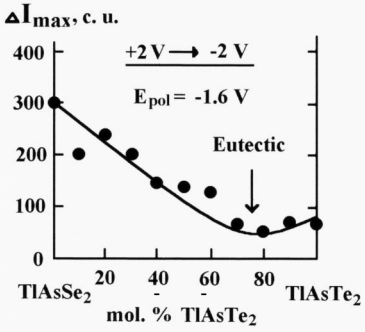

Figure 1. The concentration dependence of a maximum of a current on the voltamperometrical curve at a polarizing voltage –1.6 V in case of cathodic scan from +2 up to -2 V for glasses of system $TlAsSe_2$-$TlAsTe_2$.

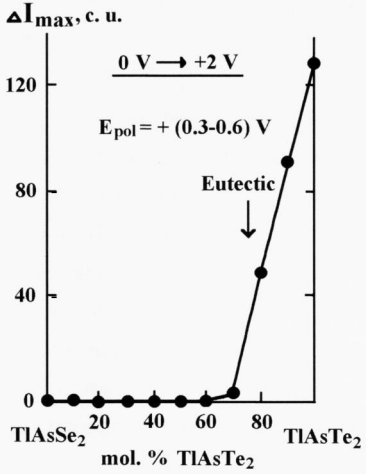

Figure 2. The concentration dependence of a maximum of a current on the voltamperometrical curve at a polarizing voltage +(0.3-0.6) V in case of anodic scan from 0 up to +2 V for glasses of system $TlAsSe_2$-$TlAsTe_2$.

For example, the peaks of a current are observed for glasses of section $TlAsSe_2$–$TlAsTe_2$ at -0.9 V, -0.5 V, -0.65 V, + (0.3 ÷ 0.6) V, + (0.8 ÷ 1.1) V, + (1.4 ÷ 1.5) V on anodic voltamperograms. The peak of a current is observed at a polarizing voltage -1.6 V on the cathodic curves for the same glasses. The height of peaks of a current depends not linearly on composition of glasses. In particular, the minimum of peak of a cathodic current at -1.6 V for section $TlAsSe_2$–$TlAsTe_2$ V in case of cathodic scan from +2 up to -2 V is found out for eutectic composition (≅ 75 mol. % $TlAsTe_2$) (fig.1).

Some results are submitted at scan of a polarizing anodic voltage from 0 up to +2 V. The anodic electrochemical activity at a polarizing voltage + (0.3 ÷ 0.6) V

begins to be shown at composition of an eutectic, that is at the content $TlAsTe_2$ more than 75 mol. % (fig. 2).The anodic electrochemical activity at a polarizing voltage + (0.8 ÷ 1.1) V begins to be shown at compositions, close to composition of an eutectic, that is at the content $TlAsTe_2$ 75 mol. %. The anodic electrochemical activity at a polarizing voltage + (1.4 ÷ 1.5) V is shown only up to composition of an eutectic (75 mol. %. $TlAsTe_2$).

The essential increase of electrochemical activity of glasses with growing of the content Tl_2Se after eutectic composition in the field of 30 mol. % Tl_2Se is observed for section As_2Se_3–Tl_2Se on cathodic and anodic voltamperograms.

The maximum of a anodic current at E ≅ - 0.7 V depends not linearly on composition of glasses of system As_2Se_3–Tl_2Se at scan of a polarizing voltage from -2 up to + 2 V. The inflection on the relevant graph is observed in the field of eutectic composition (30 mol. % Tl_2Se) and the maximum is observed at composition of chemical compound $TlAsSe_2$ (50 mol. % Tl_2Se).

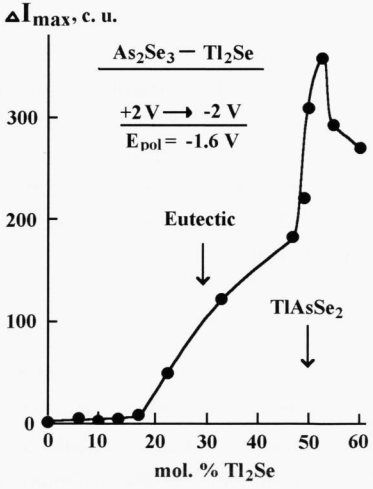

Figure 3. The concentration dependence of a maximum of a current on the voltamperometrical curve at a polarizing voltage –1.6 V in case of cathodic scan from +2 up to -2 V for glasses of system As_2Se_3-Tl_2Se.

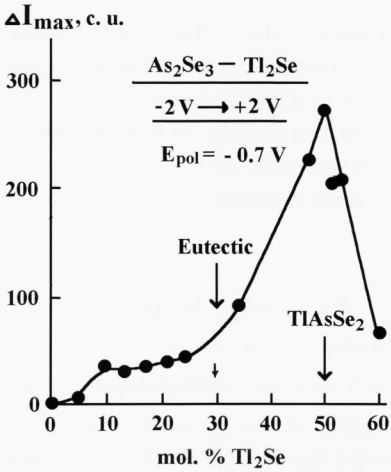

Figure. 4. The concentration dependence of a maximum of a current on the voltamperometrical curve at a polarizing voltage –0.7 V in case of anodic scan from -2 up to +2 V for glasses of system As_2Se_3-Tl_2Se.

The maximum of a cathodic current at E ≅ -1.6 V depends not linearly on composition of glasses of system As_2Se_3–Tl_2Se at scan of a polarizing voltage from +2 up to - 2 V (fig.3). The cathodic current practically is equal 0 for glasses with compositions up to 20 mol. % Tl_2Se. The electrochemical activity of glasses grows at transferring through eutectic composition (30 mol. % Tl_2Se) and reaches a maximum at composition of a compound $TlAsSe_2$ (50 mol. % Tl_2Se). The maximum of a current on the voltamperometrical curve at a polarizing voltage -0.7 V in case of anodic scan from -2 up to +2 V for glasses of system As_2Se_3-Tl_2Se has the maximal negative deflection for an eutectic glassy alloy and the edged maximum for chemical compound $TlAsSe_2$ (fig. 4).

Thus, first, for the first time it was possible by a method of voltamperometry to explore glasses with high electrical resistance, secondly, for the first time structural sensitivity of a method of voltamperometry is shown at examination of glassy alloys. The chalcogenide glasses showed not linear electrochemical activity depending on composition of eutectics and chemical compounds of investigated systems.