CRYSTALLIZATION FEATURES OF AMORPHOUS FILMS OF Sb_2S_3

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"In situ" electron beam irradiation is a spatially selective heating method which offers an opportunity to fabricate crystalline architectures in amorphous films under controlled conditions. In this work crystallization of amorphous films of Sb_2S_3 of both stoichiometric composition and with the excess of Sb was studied by the methods of transmission electron microscopy with video registration of structural changes. Irradiation of amorphous film of Sb_2S_3 with stoichiometric composition causes phase transformation, that occurs according to the scheme of layer polymorphous crystallization. A single flat ellipse-shaped crystal of Sb_2S_3 nucleates and grows in the film region under investigation. The dependence on time of the length of major and minor ellipse axis of this crystal has a linear character. As the ellipse-shaped crystal grows, its eccentricity decreases exponentially with time. The dependence on time of the fraction crystallized x at layer polymorphous crystallization has a quadratic character (Fig 1a). Wherein the relative length $\delta_0 \approx 4992$ [1].

Electron beam irradiation of amorphous non-stoichiometric films with excess of antimony initiates the predominant crystallization of Sb during the first stage of the process, and subsequent matrix Sb_2S_3 crystallization during the second stage. As the film warms up, the density n and average value of the diameter $\langle D \rangle$ of antimony particles monotonically increases and at saturation $n \approx 7.5 \cdot 10^9$ cm^{-2} and $\langle D \rangle \approx 0.029$ μm. Then in the amorphous matrix with inclusions of micro-crystals of Sb a single flat ellipse-shaped crystal of Sb_2S_3 was growing. The dependence on time of the fraction crystallized x at secondary polymorphous crystallization of Sb_2S_3 described by a power function with the exponent of 0.68. Wherein the relative length $\delta_0 \approx 9725$.

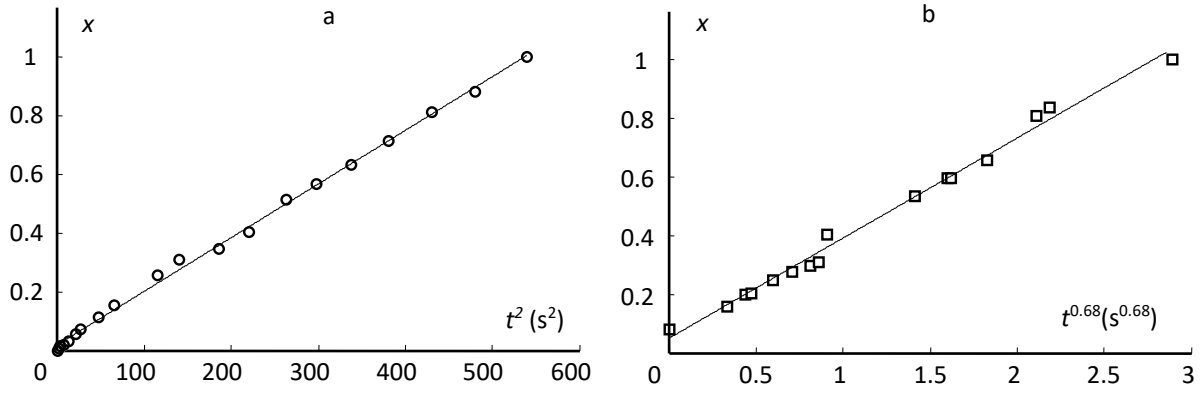

FIG. 1. Time dependence of the fraction crystallized for polymorphous (a) and for secondary (b) crystallization of amorphous films of Sb_2S_3

[1] A.G. Bagmut, Functional Materials, 2019, vol. 26, 6-15.