SUPERLATTICE STRUCTURE OF $YbAs_4S_7$ NANO THICK FILMS

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The conditions growth of thin films of $YbAs_4S_7$ obtained vacuum deposition has been defined using electron diffraction method. It is established epitaxy relations existing between long periodic superstructure phases and initial structures.

Keywords: growth of thin films, electron diffraction, super lattice structure
PACs: 68.55. + b, 68.60. + q.

The study of crystallization kinetics of amorphous thin layers of the structure of phases and thin epitaxial layers in the nanoparticles of the Yb - As - S system and the ternary of the given systems is one of the perspective directions of the limited size structures. These compounds are one of the most promising materials in the development of nanoelectronics because the use of these materials opens up new opportunities for the creation of semiconductor materials and devices on the basis of nanometer-scale structure elements. Unique properties of multicomponent nanoparticles with rare earth element are of particular importance in nanotubbing of devices that can be controlled by external magnetic fields.

$YbAs_4S_7$ film thickness of ~ 20 nm, prepared by evaporation of the synthesized substance and deposition rate with 5.0 nm/sec to crystals of NaCl, KCl, NaBr, LiF, KJ and celluloid, are obtained at room temperature in the amorphous state (Fig.1).

The electron diffraction pattern of $YbAs_4Se_7$ amorphous film shows diffuse rings corresponding to the values $s=4\pi sin\theta/\lambda=25,33;\ 41,70;\ 62,50;\ 84,20;\ 95,60$ nm^{-1} obtained in [1]. Prolonged storage of the amorphous films at room temperature does not lead to spontaneous crystallization. Heating the $YbAs_4Se_7$ amorphous layers on single crystal substrates up to Ts=473 K resulted in the formation of the crystalline phase orthorhombic modification. Polycrystalline films diffraction pattern from which indicate based rhombic crystal lattice parameters a = 1,191; b = 1,445; c = 0,403 nm, as obtained by preheated in a substrates temperature range 373 - 513 K (Fig. 2).

A different picture is observed on the electron diffraction patterns taken from samples obtained on NaCl and KCl substrates heated above 473 K. In addition to the main reflections characteristic of the known lattices $YbAs_4S_7$, new satellite diffraction reflections also appear on the electron diffraction patterns. In the temperature range of LiF substrates from 573 to 613 K, a mixture of polycrystalline samples with a mosaic single crystal is formed. (fig.3).

By increasing temperature, the intensity of the lines of the diffraction field corresponding to the polycrystalline decreases, and the point reflexes indicative of the formation of monocrystalline blocks increase. Further increase in substrate temperatures to 633 K leads to the formation of a mosaic $YbAs_4S_7$ single crystal. (fig.4.)

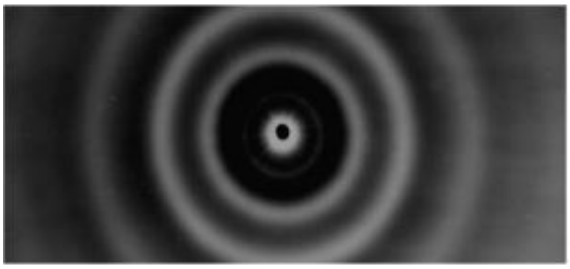

Fig.1 Electron diffraction pattern of amorphous $YbAs_4S_7$ films

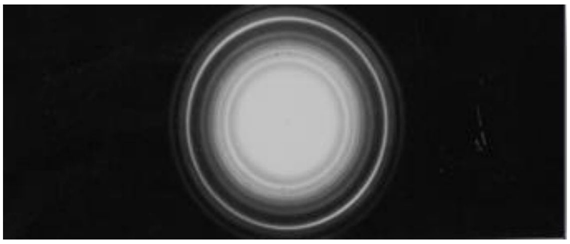

Fig.2 Electron diffraction pattern of polycrystalline $YbAs_4S_7$ films

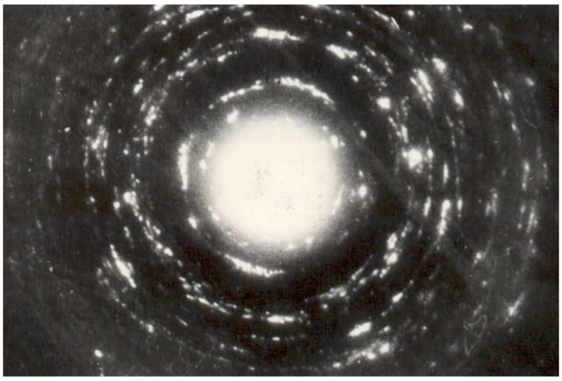

Fig.3 Electron diffraction pattern of polycrystalline samples with a mosaic single crystal.

Fig.4 Electron diffraction pattern from single crystal superstructure phase of $YbAs_4S_7$.

The electron diffraction patterns obtained from these films, including additional weak ones, are displayed in the orthorhombic cell with parameters: $a \approx 2a_0 = 2.382$; $b \approx 2b_o = 2.891$; $c \approx 2c_o = 0.806$ nm. These relationships indicate that the new crystal lattice should be considered as a superstructure of the known lattice of $YbAs_4S_7$ nanothin films.

[1] *E.G. Efendiyev and E.Sh. Hajiyev* Short – range order parameters in amorphous $YbAs_2S_4$ and $YbAs_4S_7$ films. // J. of Non – Crystalline Solids 163, 1993, p. 29– 34