MICRODIFRACTIONAL ANALYSIS OF THE STRUCTURE OF HIGH-SPEED CELLULAR CRYSTALLIZATION OF SILUMINE*

M.E. RYGINA[1,2], E.A. PETRIKOVA[2], A.D. TERESOV[2], O.S. TOLKACHEV[1], YU.F. IVANOV[1,2]

[1]*Institute of High Current Electronics, Siberian Branch, Russian Academy of Sciences (IHCE SB RAS), 2/3 Akademichesky Avenue, Tomsk 634055, l-7755me@mail.ru, 8(38-22)49-17-13*

[2]*National Research Tomsk Polytechnic University, 30 Lenina avenue, Tomsk, 634050*

The purpose of this work was to establish the laws of the formation of the structural-phase state of hypoeutectic composition silumin subjected to irradiation by an intense pulsed electron beam. Silumin AK10M2N was used as the study material. The silumin subjected to electron-beam treatment at the "SOLO" setup [1] with the following parameters: the energy of accelerated electrons is 17 keV; electron beam energy density of 25 J / cm^2; irradiation pulse duration 150 μs; number of pulses 3; pulse repetition rate 0.3 s^{-1}. Irradiation was carried out in argon plasma at a pressure of 0.02 Pa. Studies of the elemental and phase composition, defective substructure of silumin samples in the cast state and after irradiation with an electron beam were carried out using transmission diffraction electron microscopy (JEM 2100F).

It has been established that, in the cast state, the material under investigation has a multiphase structure, represented by aluminum-based solid solution grains, eutectic grains, and intermetallic inclusions. The presence in the material of inclusions plate and needle shape significantly reduces the performance characteristics of the material [2]. The irradiation of silumin with an electron beam leads to the melting of the surface layer up to 35 μm thick and to the dissolution of inclusions of the second phase. Subsequent high-speed crystallization is accompanied by the formation of a cellular structure (Fig. 1, a). Nanosized particles of the second phase are located in the volume of cells and along their boundaries (Fig. 1, b – d). It is shown that the formation of a submicro-nanoscale multiphase structure leads to an increase in the wear resistance of the material by ≈1.7 times, microhardness - by ≈1.2 times.

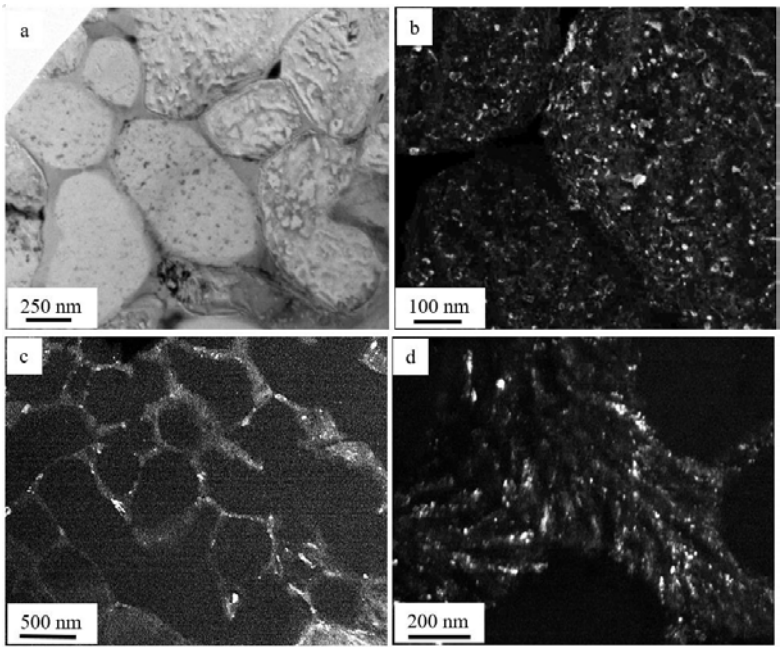

Fig. 1. Electron-microscopic image of silumin structure subjected to irradiation by an intense pulsed electron beam; a - bright field; b –d dark fields obtained in silicon reflexes.

REFERENCES

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