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The phase formation study of the hypoeutectic Mo-Si alloys, doped with REM (Sc, Y, Nd)

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Abstract

A rare earth metals (REM) effect on the phase formation of hypoeutectic Mo-Si alloys was considered by example of Sc, Y and Nd. With the help of software complex *HSC 6.1 Chemistry* (*Outokumpu*) the thermodynamic analysis of the relationship between doping elements and Mo-5.0Si (wt. %) alloy was carried, furthermore the dependences of equilibrium compositions for ternary alloys were calculated and concentration limits of doping were estimated. The binary Mo-5.0 Si (wt.%) alloy and model samples doped with Sc, Y or Nd (about 1.0 and 3.0 at.% REM) were produced by vacuum arc melting. All of them were biphasic in situ composites. The phase compositions, the occurrence forms of doping elements and their distribution in the alloys structure were determined as a result of X-ray diffraction and electron-microscope investigations of model samples. It is revealed, that the main phase components of the basic alloy and samples of doped Mo-5.0 Si (wt. %) composite are a solid solution Mo_{ss} and silicide Mo_3Si. The REM additions introduced to basic alloy collect predominantly in the silicide solid solution of complex composition $(Mo, REM)_xSi_y$. Their contents in the Mo_3Si and Mo_{ss} does not exceed tenths of a percent, with the exception of yttrium, which is distributed equally between metal solution and molybdenum silicide – 1.6 and 1.5 wt. %, accordingly. It is shown by experiments that the offered equilibrium models describe quite adequately the phase formation process and can be used to predict the composition of Sc, Y and Nd – doped alloys. It is found that the addition of REM to hypoeutectic Mo-Si alloys increases a dispersibility of the microstructure and fraction of the metal phase, thereby the ratio of a Mo_{ss}/Mo_3Si for doped composite rises average twice. For the REM under study the concentration limit of doping, excluding a formation of intermetallics with main components of Mo-5.0Si is lower than 3.0 at. % and is determined by their solubility in the silicide phase and stoichiometry of ternary compounds – substitutional solid solutions.

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