Simulation of the magnetoplastic effect in copper-beryllium alloys

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Experimental studies of the aging of BrB-2 beryllium bronze in a constant magnetic field (PMF) show a noticeable "negative" magnetoplastic effect (MPE), which consists in reducing the ductility of the alloy and increasing the microhardness to 30% [1]. In some cases, the using a accompanied by the formation of structural formations — coherent scattering blocks — with a size of less than 100 nm [2], which we have identified as the nano-magnetoplastic effect (NMPE). It is of interest to search for optimal aging regimes that lead to the greatest effects of MPE and NMPE, and to establish the physical mechanisms of these effects.

We solved a range of particular problems using density functional theory and phase field method aimed at modeling MPE and NMPE arising in model copper-beryllium alloys after aging of hardened alloy in a constant magnetic field [1]. In particular, calculations were made of the energy states of binary residual solid solutions of copper-beryllium with different concentrations of beryllium, and the phase energy of the γ-CuBe phase formed during decomposition with and without external CMF superimposed. It is shown that the energy state of the residual solid solution weakly depends on the inclusion of CMF, while the imposition of CMF gives a significant gain in the energy of the states of the γ-CuBe phase.

The results obtained are consistent with experimental data on the X-ray phase analysis of copper-beryllium alloys aged in CMF and without it, which indicate a higher quantitative content of the γ-CuBe phase formed in CMF.

References

[1] J. V. Osinskaya, A. V. Pokoev: *Magneto-plastic effect in Cu-Be alloys with Ni additives*. Defect and Diffusion Forum **363**, 186-189 (2015).

[2] A. V. Pokoev, J. V. Osinskaya: Russian Patent Specification № 2218423 (2001).