High-pressure phases in aluminum-based alloys

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The development of modern trends of aircraft building, rocket building and other science-intensive industries requires fundamentally new approaches to the creation of new generation materials, which at the same time have a set of necessary service properties. The combination of various extreme influences (ultrahigh pressures, torsion under pressure and equal-channel angular pressing, ultralow and ultrahigh temperatures, magnetic fields, ultrafast cooling from the melt, etc) makes it possible to significantly expand the regions of metastable states and obtain materials with different structural hierarchies (bulk-amorphous, quasi and nanocrystalline) and, accordingly, with different properties. The key extreme parameter in the present work is high pressure combined with high temperature and rapid quenching from the melt as applied to alloys of the Al-TM-REM type (TM—transition metal; REM—rare earth metal). Alloys of this type, both in cast and in amorphous-nanocrystalline states, are of great interest due to their high technological properties and wide use in various industries. By the method of thermobaric treatment of the melt at pressures above 7 GPa and temperatures above 1770 K, as a result of rapid quenching of the melt, new crystalline phases were obtained in Al-TM-REM alloys. Under the chosen conditions, the structure of the obtained samples is fine-crystalline, dense, homogeneous with high strength and hardness. This study allows us to conclude that the high pressure method is promising for obtaining new compounds in aluminum-based alloys. The research was supported by the Russian Science Foundation (project No. 22-22-00674).