Article ID: 1003-7837(2005)02,03-0307-01

Particulate reinforced aluminium composites fabricated by reaction casting

Chernyshova T.A.[1], Kobeleva L.I.[1], Bolotova L.K.[1], Panfilov A.A.[2], Panfilov A.V.[2]

(1. A.A.Baikov Institute of Metallurgy and Material Science RAS, Moscow 911991, Russia; 2. Vladimir State University, Vladimir 600000, Russia)

The application of particulate reinforced aluminium matrix composites (MMCs) for engine parts in modern engineering has been limited due to softening of Al matrix at the high temperature. In order to improve the high temperature strength, the new in-situ process (Reaction Casting) has been developed by which matrix is strengthened supplementary by disperced intermetallic compounds or new ceramic phases. The new phases are formed by the exothermic reaction between aluminium melt and introducing metal powder (Ti, Ni, Fe, B), or the metal oxide powder (TiO_2 NiO), or hard particles (C, B_4C, SiC).

The purpose of this work was study the structure, the composition of the interaction products and the mechanical properties of the new MMCs fabricated by reaction casting. Process was carried out by three modes: (1) by infiltration the molten aluminium into the preheated perform powder placed in the mold; (2) by introduction the preform into the melt; (3) by the mechanical stirring of particles into a molten matrix with addition an Al-Ti master alloy. The microstructure investigations show that the solidification of the composite melt contained Ti addition begins with the formation of intermetallic phases. The equiaxis rectangular crystals are identified as Al_3Ti. The size of Al_3Ti crystals increases with increase both temperature of molten Al-alloy and exposure duration until pouring.

The introduction both SiC-particles and Ti powder in matrix did not modify a shape of intermetallic compounds. When the preforms added to the Al melt consist of B_4C particles or B powder, Ti powder and SiC particles, the layers of new phases appear on the surface of SiC particles. According EDX these layers contain Ti, Al, Si, C, that form complicated compounds. A noticeable effect of B and B_4C addition into the melt is change a rectangular shape of intermetallic phase Al_3Ti into starlike or needles. The results of mechanical tests of MMCs samples by elevated temperature indicate that the intermetallic compounds are very effective for improving the high temperature strength. Samples of the MMCs containing a large amount of reinforcement (SiC, B_4C, Al_3Ti, TiB_2, TiC) have maximum hardness.

Received date: 2005-08-29