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Effect of intermetallic compound on the Al-Mg composite materials fabricated by mechanical ball milling and spark plasma sintering

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Abstract

We successfully prepared aluminum(Al)-magnesium(Mg) composite materials using a spark plasma sintering (SPS) process with pure Al and Mg powders as the raw materials. Composite materials containing 20, 50, or 80 vol.% Mg (Al-20 vol.% Mg, Al-50 vol.% Mg, and Al-80 vol.% Mg, respectively) were sintered at 410 °C and 50 MPa for 5 min. Using X-ray diffraction, intermetallic compounds such as Al_3Mg_2 and $Al_{12}Mg_{17}$ were detected, which were formed in the Al-Mg composite materials owing to the reaction between Al and Mg during SPS. The results of scanning electron microscopy with energy-dispersive spectroscopy and elemental mapping also confirmed the existence of the intermetallic compounds. The mechanical properties of the composite materials, analyzed using a Vickers hardness tester, showed that the Al-50 vol.% Mg composite material exhibited the highest hardness value of approximately 189 HV. In conclusion, the composite materials manufactured with SPS may act as lightweight and high-efficiency materials, applicable in various fields, such as the aerospace and automobile industries.

Keywords: Composites materials, Mechanical alloying, Sintering, Intermetallics.

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