Compressive Fracture Behavior of Al-based Bulk Partially Amorphous/Nanoycrstalline Alloy by Warm Extrusion of Ar Gas Atomized Powders

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Abstract

Partially amorphous/nanocrystalline Al87Ni8.5Ce3Fe1Cu0.5 (at%) powders which are less than 147 μm in diameter were fabricated by argon gas atomization and consolidating them into bulk by warm extrusion at 350°C, 400°C, 450°C. The atomized powders and extruded bulk were examined by differential scanning calorimetry, X-ray diffraction and scanning electron microscopy respectively. The compression test shows that the bulk alloy with partially amorphous/nanocrystalline exhibited high strength. the compressive strength of the bulk alloy, that were consolidated at 350°C, 400°C, 450°C, are 1035 MPa, 949MPa, and 475MPa respectively. The fractography were investigated by scanning electron microscopy.

Keywords : bulk amorphous/nanocrystalline alloys, warm extrusion, mechanical properties, Al-based alloy

Cold and Detonation Spraying of TiB_2-Cu Nanocomposites

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Abstract

Refractory properties and high conductivities of titanium diboride have motivated extensive research activity in the processing and properties of TiB_2-containing composites. Our investigations have shown that synthesis of TiB_2 in copper matrix by self-propagating high temperature reaction assisted by mechanical milling results in formation of nanostructured powders. The size of TiB_2 particles can be varied from 30 to 100 nm depending of the conditions of mechanical treatment in a ball mill. Based on these powders bulk nanostructured materials can be produced using non-equilibrium compaction (Spark-Plasma Sintering, shock wave compaction). TiB_2-Cu nanocomposites show improved stability to electric erosion under high-current arc discharge.

It is challenging to study the behavior of the nanocomposite powders under conditions of spraying so that coatings with the desired structure and properties could be produced. In this work we comparatively studied cold and detonation sprayed TiB_2-43vol.%Cu coatings. The features of the cold spraying are low temperatures of the "gas-particles" flow (from ambient temperatures to 400 ºC) and supersonic velocity of the particles accelerated to the substrate. Detonation spraying is characterized by high temperatures reaching 2000-3000 ºC. For cold spraying composite powder particles less than 40 μm in size were separated, for detonation spraying >40 and <75 μm were used. In cold sprayed coatings 50-100 nm TiB_2 particles were found that is exactly the same size of the particles in the powders being sprayed. Cold sprayed TiB_2-Cu coatings were dense and did not contain any macrodefects. In detonation sprayed coatings the size of particles increased compared to that in the powders and the coatings exhibited particular lamellar structure. Depending on the regime of detonation spraying 100-200 and 500 nm well crystallized particles of TiB_2 could be found in the coatings. Increasing temperature in detonation spraying by variation of gas composition resulted in formation of copper pools and non-uniformities in the microstructure. Cold sprayed coatings showed higher hardness compared to detonation sprayed coatings. These results have a considerable promise for development of nanostructured composite coatings from powders produced by mechanical milling.