OPEN READINGS 2016

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OPEN READINGS 2016

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March 15-18
Vilnius, Lithuania

13:00-15:00 POSTER SESSION P3

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CONSOLIDATION OF POWDERED QUASICRYSTALLINE Al–Fe–Cr ALLOY UNDER QUASI-HYDROSTATIC PRESSURE

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High strength of Al–Fe-based nanoquasi-crystalline alloys are presently of growing interest for researches involved in scientific and engineering applications. Some of this alloys show increased structural stability and, therefore, are much promising for application at elevated temperature [1]. Quasicrystalline Al–Fe–Cr-based alloys belong to the group of metal matrix nanoquasicomposites. Their microstructure consists of nanometer-sized icosahedral (i-phase) quasicrystalline particles embedded in α-Al matrix [1]. Compared to commercial Al-based alloys recommended for service at elevated temperature, Al–Fe–Cr-based nanoquasicomposite alloys show remarkable advantages in material mechanical performance because of excellent balance between high strength and sufficient ductility [2].

The present study is aimed at the structural performance of Al-based powdered alloy reinforced by metastable nanoquasicrystalline particles consolidated under quasi-hydrostatic pressure in comparison with that produced by hot extrusion process.

Feedstock powder of $Al_{94}Fe_3Cr_3$ alloy fabricated by water-atomisation technique was employed in experimentation. Consolidation of powdered $Al_{94}Fe_3Cr_3$ alloy was performed in two different ways, i.e. either by hot extrusion or under quasi-hydrostatic pressure as alternative solid-state process. Structural characterisation of consolidated under quasi-hydrostatic pressure alloy and as-extruded rod was performed by X-ray diffraction (XRD) analysis using Cu K_α radiation and scanning electron microscopy (SEM). By considering the accepted processing conditions difference in pressure, temperature and deformation mode, are illuminated and discussed. The important point concerns the difference in structure resulted from the difference in processing conditions.

Difference in characteristic features of phase composition and cross-sectional microstructure of $Al_{94}Fe_3Cr_3$ alloy performed under quasi-hydrostatic pressure and that of as-extruded rod is illuminated and discussed. Superior advantages of consolidation under quasi-hydrostatic pressure as alternative solid-state process in structural stability of $Al_{94}Fe_3Cr_3$ alloy under elevated temperature is justified experimentally by comparison with that of currently employed hot extrusion. The main benefit of consolidation under quasi-hydrostatic pressure is that the fraction volume of quasicrystalline i-phase contained by feedstock powder is entirely retained in material performed under quasi-hydrostatic pressure whereas extrusion process results in losing by roughly about 23 % of quasicrystalline phase (Fig. 1).

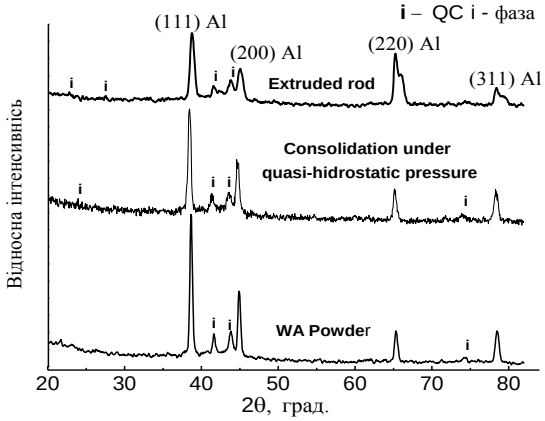

Fig. 1. XRD patterns of quasicrystalline $Al_{94}Fe_3Cr_3$ alloy

Retaining the number of nanoquasicrystalline particles at the rather low processing temperature result in remarkable strain hardening of as-consolidated under quasi-hydrostatic pressure alloy. It was experimentally proved that the essential advantage of consolidation under quasi-hydrostatic pressure $Al_{94}Fe_3Cr_3$ alloy is a combination of high hardness and rather high ductility sufficient with respect to damage tolerance.

[1] H.M. Kimura, K. Sasamory, A. Inoue // J. Mater. Res. 15,12 (2000) 2737-2744.
[2] M. Galano, F. Audebert, A. Garcia Escorial, and et al. // Acta Mater. 57 (2009) 5120-5130.