Consolidation and Mechanical Alloying of Blended Elemental Powders by ECAP: A Novel Approach

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Severe plastic deformation by equal-channel angular pressing (ECAP) is known as an effective process to obtain close to full densification in powder metallurgy (PM) of elemental and pre-alloyed powders [1]. Since ECAP consolidation is based in plastic deformation of particles, it is believed that mechanical alloying of particles may be obtained, in some extent, simultaneously with metallurgical consolidation, as some authors have already suggested [2,3]. In this research, blended elemental powders of Iron, Chromium and Nickel (AISI 304 – 18%Cr, 8%Ni, Fe) were processed by ECAP in order to evaluate the occurrence of mechanical alloying between particles. ECAP was performed in a Φ=120° die by multiple passes (1, 2, 4, 8) in Bc and A routes. For comparison, the same blend of elemental powders was processed by conventional high-energy milling. The morphology of processed billets and powders was analysed by SEM and conventional metallography. The formation of new structures by mechanical alloying was investigated by XRD and EDX. The obtained results indicate that the consolidation and mechanical alloying by ECAP is a promising process route to achieve bulk ultrafine-grained (UFG) alloys with great densification. Additional studies concerning the heat treatment of billets will be performed in order to improve diffusional activated mechanisms and determining best processing routes.

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