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Modifying ECAPed CP-Ti parts by use of Warm Caliber Rolling (WCR)

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Abstract

Presently demands for materials showing simultaneously appropriate strength and ductility is a drastic challenge. It is worth mentioning CP-Ti is an applicable material particularly for Aerospace and Bio fields. As-received CP-Ti represents relatively poor quality in terms of strength that could be solved successfully through performing Equal Channel Angular Pressing (ECAP). The most important disadvantage is that the ECAP contributes to a slump in the ductility, hence the subsequent forming processes encounter serious limitation in form of formability. In order to escalate ductility and formability of the mentioned material, Warm Caliber Rolling (WCR) has been used after ECAP. As obtained based on results of this study, specimens which underwent WCR showed the uniform plastic deformation during passes. Also higher workability of them is another advantage of post-WCR process.

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Key words: Strength, Ductility, ECAP, Warm Caliber Rolling, Formability

Introduction

Severe Plastic Deformation (SPD) processes enhance the strength of specimens through decreasing grains size by UFGs according to Hall-Petch equation [1]. Among all SPD processes, the ECAP is the most prevalent one which consists of two intersecting channel with the same sections and the part would undergo the severe shear plastic deformation with no reduction. After the ECAP, rolling process operates as a corrective process to modify the structure. The Shape rolling is a relatively complex deformation processes and could make sections of a bar, slab or billet in several passes change into shapes e.g. square, ellipse etc. Titanium and its alloys are considered to be significantly suitable *in vivo* applications because of the combination of their considerable corrosion resistance and appropriate mechanical performance [2]. It has been effective and popular to develop nanostructure of CP-Ti for medical applications by combination of ECAP with a post-forming process such as extrusion, rolling or forging [3,4,5]. Experiments for ECAP on CP-Ti at room temperature gave information about the presence of twinning bands which tend to be vanished by increasing passes [6],