ПРОБЛЕМЫ НЕДРОПОЛЬЗОВАНИЯ

МЕЖДУНАРОДНЫЙ ФОРУМ-КОНКУРС МОЛОДЫХ УЧЕНЫХ

19-21 апреля 2017 г.

Сборник научных трудов
Часть II

САНКТ-ПЕТЕРБУРГ
2017
В сборнике помещены труды молодых исследователей, участников Международного форума-конкурса «Проблемы недропользования» (19-21 апреля 2017 г.). Материалы сборника представляют интерес для широкого круга исследователей, ученых, педагогов, специалистов, руководителей промышленных предприятий и предпринимателей, работающих в области поиска, разведки, добычи и переработки полезных ископаемых.

The Volume contains works of young researchers-participants of International Forum of Young Researchers «Topical Issues of Subsoil Usage», which was held at the St. Petersburg Mining University from the 19th to 21st April 2017. The Volume can be of great interest for a wide range of researchers, scientists, university lecturers, specialists and managers of industrial enterprises and organisations as well as for businesspeople involved in exploration, prospecting, development and processing of minerals.

Редакционная коллегия: В.Л.Труша (председатель), Л.С.Синьков, Ю.М.Сищуку, Е.И.Степук.
Refinement in comparison with conventional equipment. Severe plastic deformation process was carried out at ambient temperature while the deformation rate was constant 2 mm/s. To lower the friction between a sample and EACP die, the molybdenum disulphide (MoS2) lubricant was used.

Table 1. Chemical composition (in wt. %) of the Al-3%Mg aluminum alloy

<table>
<thead>
<tr>
<th></th>
<th>Mg</th>
<th>Fe</th>
<th>Si</th>
<th>Cu</th>
<th>Ti</th>
<th>Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>as cast</td>
<td>2.86</td>
<td>0.07</td>
<td>0.07</td>
<td>0.01</td>
<td>0.01</td>
<td>rest</td>
</tr>
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Fig. 1. The initial microstructure of the Al-3%Mg alloy

The representative light optical microscope images showing the microstructure of Al-3%Mg alloy in the as-cast state are presented in the Figure 1. It is clearly visible that the microstructure of the alloy can be characterized as fine-dendritic and coarse grained. Moreover, it can be also observed that a large majority of the β-phase is distributed in the interdendritic region and on the grain boundaries as a result of the non-equilibrium solidification. The initial state microstructure consists of four phases, α-Al primary phase – matrix of an alloy, Al2Mg3, Mg2Si and Al3Fe.

Fig. 2. Structure of the AlMg3 alloy after 4 EACP passes using modified EACP die a) light microscope, b) EBSD image

Based on the metallographic analysis presented in Figure 2a it can be concluded that the size of individual grains cannot be clearly measured because of the presence of a slip, shear and micro-shear bands which forms the band-like microstructure. The EBSD orientation map (Figure 2b) shows that the microstructure possesses fine-grained with an average grain size of about ~1μm. However, it can be also seen that some grains/subgrains have a size of about 300 nm.

Table 2. Results of Vickers hardness measurements

<table>
<thead>
<tr>
<th>Condition</th>
<th>Hardness (HV)</th>
</tr>
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<tbody>
<tr>
<td>As cast</td>
<td>45 HV</td>
</tr>
<tr>
<td>Precipitation treated</td>
<td>63 HV</td>
</tr>
<tr>
<td>As cast EACP passes</td>
<td>121 HV</td>
</tr>
<tr>
<td>Precipitation treated</td>
<td>130 HV</td>
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</table>

Hardness measurements shows that using an EACP process has meaningful influence on the properties of the material. It can be observed that there is a significant improvement in hardness of the material for both investigated cases. This increase in mechanical properties is due to the grain refinement.

Summary

In this study, we showed that Equal Channel Angular Pressing method can be a very promising metalworking process which results in a significant increase in mechanical properties of the materials. Moreover, it is shown that the modification of the EACP equipment can be a promising way to introduce more strain into the material in a single pass.

References