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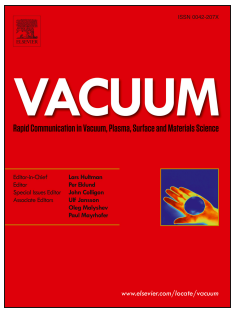

Dynamic compression behavior of 6005 aluminum alloy aged at elevated temperatures

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Dynamic compression behavior of 6005 aluminum alloy aged at elevated temperatures

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Abstract: In this study, relationship between dynamic compression behavior and microstructure of 6005 aluminum alloy artificially aged at elevated temperatures in the range of 180 ºC to 330 ºC for 0.5 h was investigated. Dynamic compression response at strain rates from 1200 s^{-1} to 2700 s^{-1} was studied using a modified split Hopkinson pressure bar system. It was observed that aging temperature has profound influence on generation of microstructure and resulting properties of the alloy. It is widely known that an increase in hardness of Al-Mg-Si alloys results with increase in aging temperature and aging time. This can be attributed to the formation of dense population of metastable β" precipitates in the microstructure of peak aged Al-Mg-Si alloys. Energy absorption was observed to increase while there was no obvious change in the dynamic stress strain behavior with increasing strain rate. However, dynamic stress-strain behavior exhibits an evident dependence on aging temperature which has an influence on the initial microstructure. At constant strain rate, homogenously distributed fine needle like β" precipitates were observed in the alloy aged at 280 ºC. This alloy exhibits higher strength but lower energy absorption in comparison with the alloys aged at other temperature. Results show that dynamic stress-strain behavior is sensitive to precipitates while aging at 280 ºC for 0.5 h is sufficient for obtaining excellent precipitation strengthening and better energy absorption ability under dynamic compression.

Keywords: 6005 aluminum alloy; Artificial aging treatment; Microstructure evolution; Dynamic compression.

1. Introduction

Artificially aged Al-Mg-Si alloys (6xxx alloys) had been increasingly employed in the fabrication of transport machines, such as automobile, aerospace and vessel bodies, due to their excellent properties like lightweight, good formability and high recycling value [1-3]. When used as automobile sheets, they are subjected to a series of coating and baking process (called bake hardening) following mechanical machining, further enhancing their strength. In order to simulate the bake hardening procedure in the laboratory, an artificial aging treatment at 170-180 ºC, 20-30 min is generally adopted [4]. However, performing bake process in this temperature and time range has been reported to be insufficient in obtaining full precipitation strengthening of these alloys. Previous studies indicated that higher temperature was needed. Studies available in literature indicate that Al-Mg-Si alloy can be strengthened by fast aging at temperatures exceeding 200 ºC [5-7]. It is therefore necessary to investigate the effects of higher artificial aging temperatures on the mechanical properties of Al-Mg-Si alloys.

Artificial aging treatments has been the most sufficient methods of improving the mechanical properties of Al-Mg-Si alloys [8-10]. In order to investigate the relationship between artificial