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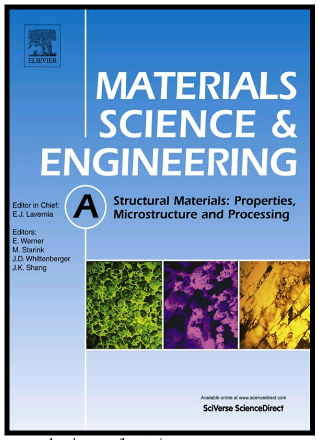

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Effect of microstructure evolution on high cycle fatigue behavior of brass

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ABSTRACT

The fatigue behavior and the microstructure of brass induced by HCF test are investigated systematically. The fatigue fracture morphologies are characterized by SEM. The microstructures are analyzed by OM and TEM. It is found that crack initiation of brass is accompanied by micro-cracks. In crack propagation region and final fracture region, secondary cracks and the dimples can be observed, respectively. The number of the twins increase, which can be attributed to the plastic deformation when brass subjects to HCF test. A series of change in dislocation structures refines the original grains into sub grains by forming new boundaries in the original grains. In addition, uneven microstructure distribution in the process of cyclic loading causes stress concentration, which generates the PSBs turned into preferential cracking initiation. The high cycle fatigue fracture mechanism of brass induced by dislocation structure evolution is proposed finally.

Keywords

HCF; Dislocation structures; Microstructure evolution; Brass

1. Introduction

In industrial applications, mechanical parts, such as springs and bearings, often need to work under cyclic loading condition, which leads to fatigue failure [1-5]. Therefore, the fatigue resistance is essential to guarantee the service life of mechanical parts. Copper alloy characterized by excellent workability and fatigue resistance is widely used for applications in manufacturing all kinds of cyclic loading mechanical parts [6-8]. Accordingly, it should be paid more attention to the fatigue properties of copper alloys.

In general, the fatigue property of materials is related to the plasticity [9]. During the process of fatigue testing, materials are subjected to the external force, which leads to the plastic deformation, even the fatigue fracture eventually. It is well known that the fatigue fracture process of materials can be divided into crack initiation stage, crack propagation stage and final fracture stage. Moreover, the three stages have a clear relationship with changes in the microstructure [10-12]. According to the research of Yue et al. [13] and Huang et al. [14], the fatigue properties of titanium alloys with different microstructure vary a lot. Thus, microstructure plays a very important role in the study of the fatigue properties of materials. Some researchers have explored on the relationship between the fatigue properties and microstructure of materials [15-18]. Yu et al. [15] revealed the grain refinement mechanism of magnesium alloys during cyclic loading. The