

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

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CHARACTERISTIC MEASUREMENTS AND TESTS OF NEWLY LIGHTWEIGHT MG-LI ALLOYS

Abstract

The overweight of spacecraft not only costs more fuel, but also reduces its competitive power in aerospace field. The light weight design is one of key technologies of spacecraft system design. Traditional Al alloys cannot satisfy current requirement. It is urgent to find an alternative material with light weight and high strength.

Magnesium lithium alloy (Mg-Li alloy) is the lightest metal material, which is known as “21st century green engineering material”. Because of its low density and high strength, it is a promising material satisfying the light weight requirement of aerospace application. It is reported that the Dow Chemical Company had produced high performance Mg-Li alloys that has been successfully used in aerospace field. Another example is the Chinese Xi’an Sifang Ultra-light Materials Co. Ltd. Through years of effort, it has successfully developed the first generation of Mg-Li alloys with the contents of Li between 4

Because the Mg-Li alloy is easily to be oxidized and corroded in air, the Mg-Li alloy should adopt some surface treatments, such as chemical conversion coating, micro arc oxidation coating and nickel-plating coating. According to space environment, this paper focused on characteristic measurements and reliability tests, including mechanics, thermology, electricity and radiation. Mechanical performance tests include bonding shear strength measurement, coating binding force measurement, and thread embedded parts pull-off test. Thermal performance tests include temperature cycling test, humidity-heat test, and heat transmission coefficient measurement. Electricity performance test mainly involves surface film resistance measurement. 1.0MeV and 1.5MeV high energy electrons were adopted for the radiation test.

The results indicates that the chemical nickel-plating coating and micro arc oxidation coating are more stable, which have good mechanical strength and certain anti-radiation capacity. After several cycles of performance tests, no surface peeling and bubble phenomenon are found. Mg-Li alloy has a great potential for application in the field of aerospace. According to features of different oxidation method, several Mg-Li alloy applications for spacecraft are proposed. The nickel-plating coating technology can be used for instrument supporters or housings. The micro arc oxidation coating technology can be used for embedded parts.