Hot compressive flow stress modeling of homogenized AZ61 Mg alloy using strain-dependent constitutive equations

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Abstract

The experimental stress-strain data from hot compression tests were used to establish constitutive equations in a homogenized cast AZ61 Mg alloy. Hot compression tests were conducted using the Gleeble 3500 thermal simulation machine in the temperature range of 250 to 450 °C and strain rate range of 1 × 103 to 1 s1. The constitutive analysis was performed based on the effect of strain on the constitutive parameters. Constitutive equations as a function of strain were constructed according to the hyperbolic sine constitutive law. The correlation between the strain-dependent constitutive parameters and flow behavior was analyzed. Results showed that variations in the constitutive parameters with strain were associated with the stress-strain behavior. A comparatively higher scattering was obtained at low strains based on the constitutive equation with the strain-dependent stress multiplier (α) determined by power and exponential laws. However, the constitutive analysis with a constant α determined by the hyperbolic sine constitutive equation showed better estimations between the calculated and experimental flow stresses under different temperature and strain rate conditions used in this study.

Keyword：AZ61 Mg alloy; constitutive analysis; flow stress modeling; strain-dependent constitutive parameters