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Abstract
The low temperature transport properties of Cerium and lanthanum-based bulk metallic glasses are investigated in this thesis. Samples with formula of Ce70AlXCu(30-x)（x = 5,10, 15, 20, 25）、La70AlXCu(30-x)（x = 5, 10, 15, 20, 25） were fabricated by argon arc-melting method. The structures of all Ce-based samples are amorphous confirmed by x-ray diffraction patterns. For all sample, the low temperature electrical transport properties were measured from 10 to 300 K; the thermogravimetric analysis (TGA) and room temperature ultrasonic sound velocity measurement were carried out in our studies.
These amorphous metallic glasses show no long-range ordering and the free electrons in the sample feeling non-periodic potential. The resistivities of all Ce-based and La-based bulk metallic glasses are higher than copper metal about two orders of magnitude; These peculiar transport behaviors can be described with two regimes of temperature, one temperature above 100 K and another below 50 K. The slopes on the temperature dependent resistiviy are quite different with each temperature regime, which shows different phases existing at different temperature. The resistivity behaviors from 50 to 100 K might be due to the cooperation interactions of the magnetic Ce-ion in the sample. As substituting Cu atoms with Al atoms, the resistivity does not decrease even with more free electrons contributed from Al. The La-based samples show electricity measurements without obvious maximum like Ce-based BMG but turning points emerging on the temperature range near 20 to 50 K .The lower temperature transport behaviors need further investigations on magnetic behavior or the low-temperature ultrasonic measurement.
The TGA results show the highly chemical reaction above 700 K for Ce-based BMGs; the reactions of all La-based BMGs were not crucial compared with Ce-BMG and the decaying temperature were near 600 K.
From the room-temperature longitudinal sound-velocity measurement results of Ce-based BMG, the velocity changed drastically as Al-atom component change from below 15% to higher than 15%; the sound-velocity of La-based BMG decreases with increasing Al-atom constituents.
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