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Cu基块状非晶晶化过程的微区变形及力学性能

李春燕1, 2，寇生中1, 2，胡 勇1, 2，丁雨田1, 2，许广济1

(1. 兰州理工大学 甘肃省有色金属新材料省部共建国家重点实验室，兰州 730050；2. 兰州理工大学 有色金属合金省部共建教育部重点实验室，兰州 730050)

摘 要：在玻璃转变温度以下选择350、400、475及600 K进行1 h的等温退火，用纳米压痕仪、扫描电镜等研究Cu基块状非晶晶化过程的力学性能及变形。Cu基块状非晶在纳米压头作用下体现弹–塑性变形方式，载荷—位移曲线和压痕周边多重剪切带的特征证明了塑性变形的存在。350 K退火试样具有较大的压痕硬度HV和弹性模量*E*值及较小的塑性变形量d_n值；400 K退火后，HV和*E*值显著减小，d_n值明显增大；475 K退火后，有少量晶体相析出，但合金以非晶的特性为主，HV和*E*值继续减小，d_n值继续增大；600 K退火后，晶体相进一步长大和析出，其固溶强化和弥散强化使合金的HV和*E*值有所增加，d_n值略有减小。对塑性变形机理进行了初步分析。

关键字： Cu基块状非晶；晶化；纳米压痕；变形；力学性能

Deformation and mechanical properties of Cu-based bulk metallic glasses during crystallization

LI Chun-yan1, 2, KOU Sheng-zhong1, 2, HU Yong1, 2,DING Yu-tian1, 2, XU Guang-ji1

（1. State Key Laboratory of Gansu Advanced Non-ferrous Metal Materials, Lanzhou University of Technology, Lanzhou 730050, China; 2. Key Laboratory of Non-ferrous Metal Alloys, Ministry of Education, Lanzhou University of Technology, Lanzhou 73005, China）

Abstract:350, 400, 475 and 600 K below glass transition temperature were chosen for isothermal annealing for 1 h. Mechanical properties and deformation of Cu-based bulk metallic glasses(BMGs) during crystallization were studied with nanoindentation instrument and scanning electron microscope(SEM). The results indicate Cu-based BMGs deform in elastic-plastic modes under a nanoindenter. Load-displacement curve and multiple shear bands around a nanoindenter confirm the existence of plastic deformation. The sample annealed at 350 K exhibits higher microhardness(HV), elastic modulus(E), and lower plastic deformation(dn); HV and E values decrease and dn value increases significantly at 400 K; crystal phases exist at 475 K, but the major properties of the alloy is amorphous. HV and E values reduce and dn value increases continually; with growth and precipitation of crystal phases at 600 K, solid solution strengthening and dispersion strengthening of the

phases slightly augment HV and E values, and reduce dn value. The plastic deformation mechanism during crystallization is preliminarily analyzed.

Key words: Cu-based bulk metallic glass; crystallization; nanoindentation; deformation; mechanical properties

地 址：湖南省长沙市岳麓山中南大学内 邮编： 410083

电 话： 0731-8876765，8877197, 8830410 传真： 0731-8877197

电子邮箱： f-ysxb@mail.csu.edu.cn