

论文

纳米晶体材料屈服应力与晶粒尺寸的依赖关系

朱文辉,周光泉,程经毅

中国科学技术大学,国防科学技术大学

摘要: 本文把纳米晶体材料等效成由晶粒基体和晶间界面夹杂组成的复合材料,对纳米材料屈服应力特征作了详细讨论.依此得到了纳米晶体材料屈服应力偏离Hall-Petch关系的尺寸范围,这一范围强烈地依赖于界面的性质.依据所得到的结果,解释了屈服应力随晶粒尺寸减小而降低的反常实验现象.文中还指出屈服应力对晶粒尺寸的依赖曲线可划分为线性区,非线性区,反常偏离区和不确定区四个区域,屈服应力的尺寸效应不但需要指定晶粒尺寸的范围,而且还取决于界面的性质.在细观理论的基础上,对夹杂体弹性模量的确定提出了具体的建议.

关键词: 纳米晶体材料 屈服应力 界面 Hall-Petch关系

DEPENDENCE OF YIELD STRESS ON GRAIN SIZE OF NANOCRYSTALS

ZHU Wenhui; ZHOU Guangquan; CHENG Jingyi(University Science Technology, Hefei 230026) (National University Defence Technology, Changsha 410073)

Abstract: A mesoscopic discription on the yield stress of nanocrystals was proposed by regarding the nanocrystals as a composite of crystalline matrix and inclusion of intercrystalline layers. By introducing effective yield stress and effective modulus, a range of critical size, over which the deviation of yield stress from Hall-Petch prediction will occur, was estimated for several typical nanocrystals, and the range depended sensitively on the properties of intercrystalline interfaces. Comparison between the obtained results and the experimental data could explain the size effect on yield stress quite well in the given range of nanocystalline size. The dependence of yield stress on grain size could be divided into four regions-linear, nonlinear, abnormal deviation and indefinite region. A method was suggested to determine the elastic modulus of inclusions starting from the mesoscopic analysis.

Keywords: nanocrystal yield stress interface Hall-Petch relation

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通讯作者:

作者简介:

作者Email:

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