New Insight into the Size Effect on Twinning at the Nanoscale for hcp Metals

*** Y.F. Guo, S. Xu, X.Z. Tang, and Y.S. Wang**

Institute of Engineering Mechanics, Beijing Jiaotong University, Beijing, China

*Corresponding author: yfguo@bjtu.edu.cn

A new insight into the size effect on twinning at the nanoscale for hcp metals is presented based on the analysis of the strain due to the lattice rotation caused by twinning. We also demonstrate this new criterion in hcp magnesium and titanium single crystal using molecular dynamic simulations. The results show that <c+a> pyramidal slip dominates the deformation under compression at the nanoscale, which is consistent with our theoretical analysis. Our finding reveals the essence of the size effect on deformation twinning, also gives a pronounced explanation for the so-called strength differential (SD) effect.

Keywords: Size effect, Twinning, Nanoscale, hcp metals, molecular dynamics