11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Theoretical model for compression collapse of gold particles at submicron scale

JIANQIAO HU[1], ZHANLI LIU[1]*†, YINAN CUI[1], ZHUO ZHUANG[1]†

[1]Applied Mechanics Laboratory, School of Aerospace, Tsinghua University, Beijing, China

†corresponding author: zhuangz@tsinghua.edu.cn, liuzhanli@tsinghua.edu.cn

Abstract

A large displacement collapses is observed recently in the compression experiment of single crystalline gold particles with size ranging from 300~700nm diameters. With the happening of large strain burst numerous dislocations escaped from the free surface and the hemisphere was deformed as frustum of a cone. In this study a theoretical model based on the energy minimization principle is developed to explore the mechanisms before and after the particle collapse. The self-energy of dislocations, the dissipated energy of dislocation nucleation and the surface energy of newly created surface are all included in the equilibrium analysis. Furthermore, a micromechanics model based on dislocation pile-up assumption is developed to predict the critical condition for the happening of displacement collapse. The theoretical results agree well with experimental observations.

Keywords: *single crystal gold particle; compression collapse; micromechanics model; submicron scale*