 ICCES, vol.10, no.3, pp.89-89

A study of simulation of down pressing nanoscale depth of abrasive grains in different shapes by two dimensional quasi-steady molecular statics model

Zone-Ching Lin[1], Ming-Long Huang[1]

Summary

The paper develops a two dimensional quasi-steady molecular staic model to simulate the vertical down press copper workpiece by down press the nanoscale depth of abrasive grains in different shapes. The research of the down pressing copper workpiece of abrasive grains in this paper uses the hexagonal close packed diamond abrasive grains to down press the perfect face-centered cubic copper. The paper's simulation of down pressing nanoscale depth model of abrasive grain by two dimensional quasi-steady molecular statics model is a step by step to down press copper workpiece by diamond abrasive grain. It is assumed that each atom of the down pressed copper workpiece moves for a small distance when the diamond abrasive grain down presses a small step. Morse's equation of equilibrium of forces in X direction and Y direction is applied to find the position of new movement of each atom of the down pressed copper workpiece. Since the equation of equilibrium of forces has two unknowns to be solved, which are the coordinates of x and y positions, the paper employs engineering optimization method to acquire the new movement position of each atom of the down pressed copper workpiece when the equation of forces is met.After that, from the calculated new position of each atom of the down pressed copper workpiece, the displacement of each atom of the down pressed copper workpiece is calculated based on the calculated displacement of each atom of the down pressed copper workpiece. Then, adopting the concept of shape function of finite element method, equivalent strain is calculated. From the relations of the nanoscale flow stress-strain curve of copper workpiece, the equivalent stress of the down pressed copper workpiece is calculated. Furthermore, the paper investigates the down pressing nanoscale depth of the abrasive grains in three different shapes, including circular shape, 60-degree tapered shape and 120-degree tapered shape, on copper workpiece. The paper also analyzes the acquired down press force, equivalent stress and equivalent strain. Besides, the simulated results of this paper are compared with the results shown in reference. When the down press is at the same nanoscale depth, their down press forces are compared. It verifies the rationality of the paper's developed simulation model of down pressing nanoscale depth of abrasive grain on workpiece by two dimensional quasi-steady molecular statics.

keywords: molecular statics, nanoscale, abrasive, down press

[1]Department of Mechanical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, R.O.C. Email: zclin@mail.ntust.edu.tw