Accepted Manuscript

Title: Molecular Dynamics Simulation of Subnanometric Tool-Workpiece Contact on a Force Sensor-Integrated Fast Tool Servo for Ultra-Precision Microcutting



Author: Yindi Cai Yuan-Liu Chen Yuki Shimizu So Ito Wei Gao Liangchi Zhang

PII:	S0169-4332(16)30206-9
DOI:	http://dx.doi.org/doi:10.1016/j.apsusc.2016.02.046
Reference:	APSUSC 32564
To appear in:	APSUSC
Received date:	2-12-2015
Revised date:	2-2-2016
Accepted date:	4-2-2016

Please cite this article as: Y. Cai, Y.-L. Chen, Y. Shimizu, S. Ito, W. Gao, L. Zhang, Molecular Dynamics Simulation of Subnanometric Tool-Workpiece Contact on a Force Sensor-Integrated Fast Tool Servo for Ultra-Precision Microcutting, *Applied Surface Science* (2016), http://dx.doi.org/10.1016/j.apsusc.2016.02.046

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

1 2

Molecular Dynamics Simulation of Subnanometric Tool-Workpiece Contact on a Force Sensor-Integrated Fast Tool Servo for Ultra-Precision Microcutting

Yindi Cai^a, Yuan-Liu Chen^{a^{*}}, Yuki Shimizu^a, So Ito^a, Wei Gao^a, Liangchi Zhang^b
^aDepartment of Nanomechanics, Tohoku University, Sendai, 980-8579, Japan
^bSchool of Mechanical and Manufacturing Engineering, The University of New South
Wales, NSW, 2052, Australia

7

8 Abstract

This paper investigates the contact characteristics between a copper workpiece and a 9 diamond tool in a force sensor-integrated fast tool servo (FS-FTS) for single point diamond 10 microcutting and in-process measurement of ultra-precision surface forms of the workpiece. 11 Molecular dynamics (MD) simulations are carried out to identify the subnanometric 12 elastic-plastic transition contact depth, at which the plastic deformation in the workpiece is 13 14 initiated. This critical depth can be used to optimize the FS-FTS as well as the 15 cutting/measurement process. It is clarified that the vibrations of the copper atoms in the MD model have a great influence on the subnanometric MD simulation results. A multi-relaxation 16 time method is then proposed to reduce the influence of the atom vibrations based on the fact 17 that the dominant vibration component has a certain period determined by the size of the MD 18 model. It is also identified that for a subnanometric contact depth, the position of the tool tip 19 20 for the contact force to be zero during the retracting operation of the tool does not correspond to the final depth of the permanent contact impression on the workpiece surface. The accuracy 21 22 for identification of the transition contact depth is then improved by observing the residual 23 defects on the workpiece surface after the tool retracting.

24

Keywords: molecular dynamics, microcutting, measurement, contact depth, elastic-plastic
transition, fast tool servo, surface damage

27 *Corresponding authors. E-mails: <u>yuanliuchen@nano.mech.tohoku.ac.jp</u> (Y. L. Chen)

28

Download English Version:

https://daneshyari.com/en/article/5355233

Download Persian Version:

https://daneshyari.com/article/5355233

Daneshyari.com