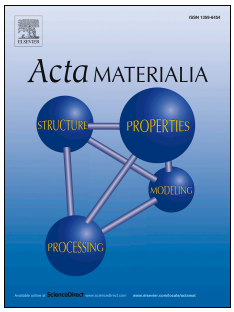
Accepted Manuscript



Irregular bending growth of free-standing Al microwire by electromigration

Yasuhiro Kimura

PII: S1359-6454(18)30554-8

DOI: 10.1016/j.actamat.2018.07.026

Reference: AM 14703

To appear in: *Acta Materialia*

Received Date: 23 January 2018

Revised Date: 24 April 2018

Accepted Date: 9 July 2018

Please cite this article as: Y. Kimura, Irregular bending growth of free-standing Al microwire by electromigration, *Acta Materialia* (2018), doi: 10.1016/j.actamat.2018.07.026.

Irregular bending growth of free-standing Al microwire by electromigration

Yasuhiro Kimura*

Department of Finemechanics, Graduate School of Engineering, Tohoku University, Aoba 6-6-01, Aramaki, Aoba-ku, Sendai 980-8579, Japan

Abstract

Electromigration (EM) can generate free-standing micro- and nanowires that are occasionally irregularly bent to kinked and curved or collapsed shapes. The mechanism behind irregular bending was discussed based on electron microscopy data. Al microwires with the bamboo structure or single crystals were kinked at the grain boundaries (GBs) or at locations without GBs, respectively. Dislocation network and clusters of oxidation products were found in the wires. The kinking mechanism was attributed to the changing growth direction owing to GBs and the different growth rate of the outer circumference of the wire owing to the friction between the clusters and the TiN passivation. No buckling owing to gravity was observed. The high growth rate of Al microwires would be accompanied by low resistance in the discharge through a hole, which is attributed to the uniform friction along the periphery of the hole. In addition, the low wire diameter minimized the differences in growth rate. Hence, the increase in the growth rate of the wire by increasing the input current and substrate temperature and the decrease in the wire diameter favor wire straightness.

Keywords: Microwire, Electromigration, Aluminum, Kink, Grain boundaries

* *E-mail address*: kimura@ism.mech.tohoku.ac.jp