Localized Electrochemical Deposition Process and Mechanical Property Measurements for One-Dimensional Structure

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ABSTRACT

In general, electrochemical deposition has been employed to deposit metal on the metallic surface (plating) or to deposit metal for duplicating the patterns prepared by photolithographic process (electroforming). However, if by locally controlling the induced electric field to deposit metal, the lithography process for prepare the pattern by marks can be spared. Thus, it can reduce fabrication cost and error of masks or molds. Furthermore, using a localized electrochemical deposition can deposit micro-sized structures with high aspect ratio easily. Usually, the structure which is fabricated by micro-process, demonstrates mechanical properties different from its bulk materials counterpart. In this study, we use a localized electrochemical deposition to fabricate a cantilever beam of Cu which is in the dimensions of micrometers. The effects of various control parameters of the deposition process are also studied. The first resonance frequency of the deposited structure is measured by the forced vibration at its base. The Young's modulus of the micro-structure is then inferred from the resonance frequency and several possible factors which affect the apparent stiffness are discussed. Because a stepping mode is used to deposit micro-structure in the experiment, a nodular micro-structure has been obtained. Therefore, this study also design a magnification mechanism which is composed of linkages connected by flexure hinges and is driven by a piezoelectric actuator. The continuous movement instead of stepped movement of the electrode with feedback control, should overcome the shortcoming of the previous study.

Keywords : Localized electrochemical deposition, Cantilever, Young's modulus, Piezoelectric actuator, Flexure hinges.


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