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Effect of supercritical carbon dioxide on micro-mechanical properties of electrodesposited gold

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Gold materials are often used in the electronic industry due to their high chemical stability, corrosion resistance, electrical conductivity and density. Electrodeposition (ECD) has been widely employed in preparation of Au materials for micro-electrical-mechanical system (MEMS) devices, i.e., capacitive accelerometer. However, mechanical strength of Au materials is relatively low when compared with other metallic materials, which is often a concern in practical applications in MEMS. In previous studies, grain refinement effect was observed in nickel films prepared by ECD with the electrolyte containing supercritical carbon dioxide ($scCO_2$), which results a significant enhancement in the mechanical properties according to Hall-Petch relation. In this work, the ECD with $scCO_2$ (ECD-$scCO_2$) was applied in fabrication of Au materials, and the micro-mechanical properties were evaluated. Two kinds Au films with 50 μm thickness were first prepared by the ECD with sulfite-based Au electrolyte: One is conventional ECD (ECD-CONV) without employing the $scCO_2$; the other is ECD-$scCO_2$. Micro-pillars were fabricated from the Au films by focus ion beam (FIB) milling, where the pillar size was fixed at 15×15×30 μm (aspect ratio is 2). Micro-compression tests were carried out using a testing machnine specially designed in our group. For the ECD-$scCO_2$, a compressive strength of ~800 Mpa was obtained, which is far larger than the ECD-CONV pillar (500 MPa). The results indicated that employing $scCO_2$ in the Au ECD process is effective in enhancing the mechanical properties of the Au materials.

Biography

Haochun Tang has received his BS degree in Mechanical Engineering from Chun Yuan Christian University, Taoyuan, Taiwan, in 2011, MS degree in Innovative and Engineered Materials from Tokyo Institute of Technology, Yokohama, Japan, in 2015 and is currently working towards PhD degree in Materials Science and Engineering at Tokyo Institute of Technology. His research interests include the effects of supercritical carbon dioxide in electrodeposition of metallic materials.

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