

Electrodeposited High Strength Au-TiO₂ Nano Composite Film for MEMS Devices

IIR, Tokyo Tech¹,

Yu-An Chien¹, Tso-Fu Mark Chang¹, Chun-Yi Chen¹, Daisuke Yamane¹, Hiroyuki Ito¹, Katsuyuki Machida¹, Kazuya Masu¹, Masato Sone¹

E-mail: Chien.y.aa@m.titech.ac.jp

In this study, high strength Au-based composited films was achieved through TiO₂ nanoparticles (NPs) reinforcement [1]. The Au-TiO₂ composite film was electrodeposited onto a copper plate with a 1 cm² surface area using galvanostatic method. Different surface morphologies of composite films with different TiO₂ contents were observed through scanning electron microscope (SE4300, Hitachi) images (shown in Figure 1). The surfaces were found to be composed of particles, and a decrease in the particle size was observed with an increase in amounts of TiO₂ in the film from 0 to 2.72 wt%. Broadened XRD peaks of the Au-TiO₂ composite film containing 2.72 wt% TiO₂ shown in Figure 2 indicated grain refinement caused by co-deposition with the NPs. The primary characteristic peak of TiO₂ at $2\theta = 25.1^\circ$ also appeared in the XRD patterns of the Au-TiO₂ composite film containing 2.72 wt% TiO₂ NPs (inset of Figure 2). Figure 3 shows the scanning ion microscope (SIM, FB-2100, Hitachi) images and a stress-strain curve of a micro-pillar fabricated from the composite film containing 2.72 wt% TiO₂ NPs. Yield strength of the pillar was 0.84 GPa, which was much higher than that of pure gold electroplated through conventional method [2].

References

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- [2] H. C. Tang, C. Y. Chen, T. Nagoshi, T. F. M. Chang, D. Yamane, K. Machida, K. Masu, M. Sone, *Electrochem. Commun.*, Vol. 72 (2016), pp. 126-130.

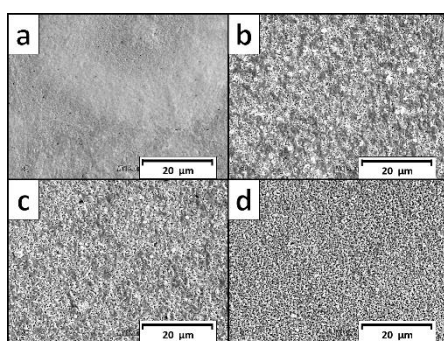


Figure 1. Surface morphology of electrodeposited (a) Au film and (b-d) Au-TiO₂ composite films containing 1.45, 1.69, and 2.72 wt% TiO₂.

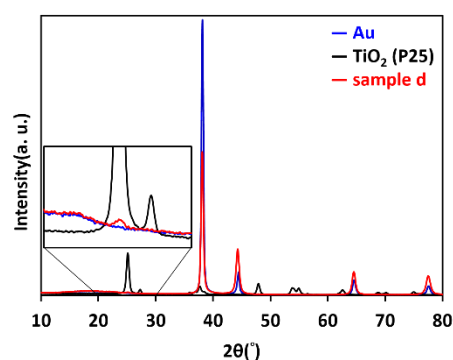


Figure 2. XRD spectra of Au, TiO₂ NPs (P25), and Au-TiO₂ composite film. Inset of Figure 2 shows the zoomed spectra of $2\theta = 20^\circ$ to 30° .

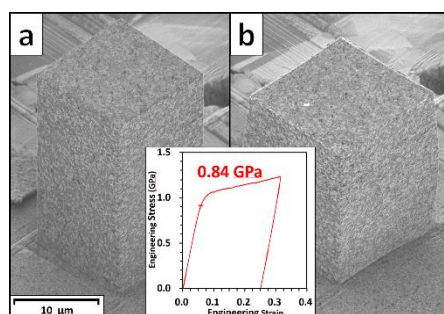


Figure 3. SIM image of micro-pillar fabricated from Au-TiO₂ composite film containing 2.72wt% TiO₂ (a) before and (b) after micro compression test. Inset of Figure 4 shows the stress-strain curve and 0.2% offset yield strength of the composite film.