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Yun Young Kim

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Measurement of Young's modulus of a thin silicon nitride film using an ultrasonically-actuated microcantilever

Yun Young Kim[*†]

[*]Division of Mechanical, Automotive, and Robot Component Engineering, Dong-eui University, Busan 47340, Republic of Korea

Abstract

The Young's modulus of a thin silicon nitride (Si_3N_4) film was evaluated using an ultrasonically resonating microcantilever in the present study. The length, width, and thickness of the silicon microcantilever are 45 μm, 25 μm, and 1.78 μm, respectively. A 380 nm thick Si_3N_4 film was deposited on the microcantilever surface using a plasma enhanced chemical vapor deposition technique. The free vibration of the microcantilever was induced by an ultrasonic transducer, and detected by a Michelson interferometer. Results show that the optical measurement successfully captures the vibration mode of the microcantilever, which made it possible to determine the Young's modulus of the Si_3N_4 film. The result was validated by the nanoindentation testing, and in good agreement within error ranges. The present investigation proposes a novel method to evaluate material properties of nanoscale thin-films and coatings with enhanced sensitivity and detectability.

Keywords: Microcantilever; Silicon nitride; Thin-film; Young's modulus; Materials testing

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[†] Corresponding Author (E-mail: ykim@deu.ac.kr; TEL: +82-51-890-1649; FAX: +82-505-182-6891)

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