Electrostatic micro-actuation system to evaluate the elastic moduli of metals with the application of DC voltage

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Abstract

Elastic modulus is the core of mechanical spectroscopy to study the actuation-based performance, lifetime, reliability, and stability of pure metals as well as alloys. In this investigation, a prototype system has been discussed for measuring the elastic properties of pure metals such as Cu (99.99 %), Al (99.99 %), and Ni (99.99 %) using electrostatic force. The samples were processed by cold rolling producing specimens of 10-100 microns thickness. A variable potential difference ranging from 1 V to 370 V DC was supplied, thus applying a variable electrostatic force to the specimen. The whole system is concentrated on the measurement of micro- to macroscale levels, and a powerful optical microscope evaluates the deflection. The current system has been used to estimate the samples' elastic moduli and then compare it with those obtained by the well-known tensile stress-strain testing method. Finally, the experimental principle of measuring elastic modulus was developed to conduct further research on the metallic materials that are induced by external stimuli like magnetic fields, lasers, and/or heat.

Keywords: Lattice strain, Electrostatic force, Static deflection, Micro-actuation, Tensile stress.