Special Issue on Advances in Devices and Materials for Stress–Strain Sensing

Preface

The large piezoresistance coefficient of single-crystal silicon was discovered by Smith in 1954. Since then, the piezoresistance in various types of advanced materials is widely used as a stress–strain sensing element in micro-electromechanical systems (MEMS). Furthermore, to investigate the physical origin of the piezoresistance, multiscale simulations based on discrete first-principles electronic band structure and continuum micromechanics have been studied for various types of advanced materials.

This special issue is focused on the state-of-the-art multiscale stress–strain sensing technologies using advanced piezoresistance materials and devices. The first paper describes the first-principles calculation of the longitudinal gauge factors of transition metal dichalcogenide monolayers based on a strain-induced change in electrical conductivity through carrier redistribution in conduction and valence bands. The second paper describes microfabrication and experiments concerning large piezoresistance in monolayer and multilayer graphene films. The third paper describes a new piezoresistance tensor equation for a cubic single crystal and its application to multiaxial stress transducers. The fourth paper describes an overall piezoresistance tensor for polycrystalline aggregates representing the texture-induced piezoresistance anisotropy. The last paper describes a new fatigue testing device with integrated piezoresistive strain gauges to shorten the testing time for investigating tensile-mode fatigue characteristics of single-crystal silicon. Therefore, each paper in this issue yields new physical and practical insights on stress–strain sensing technologies based on piezoresistance.

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