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Synthesis and Characterization of a NiO-ZnO Semiconductor Junction for an Electromechanical Effect

ZnO, a semiconductor metal oxide, exhibits a property known as piezoelectricity, which is a product of its crystalline lattice anisotropy and tetrahedral molecular unit cell. In this research, ZnO was produced using a sol-gel synthesis route utilizing ethanol as a solvent and zinc acetate as a precursor reactant. A complexing agent, such as triethanolamine or ethylene glycol, was combined with the solutions after the zinc acetate dihydrate partially dissolved into the solvent. Upon dissolution of the precursor and the formation of colloidal nanoparticles, the solutions were deposited via spin coating onto nickel substrates with an oxidized nickel upper surface in order to establish a NiO-ZnO P-N type junction responsible for an increased electromechanical effect. Characterization of this material was conducted using X-Ray diffraction and scanning electron microscopy. An upper gold electrode that was sputtered using a Denton Vacuum sputtering machine with a gold target coated a portion of the film surface in order to provide an upper conductive contact for wire attachment; the nickel substrate functioned as the second electrode contact. The electromechanical effect was analyzed by deforming the ZnO-NiO films on the substrate by using a programmable linear actuator and an oscilloscope that was attached to the conductive electrodes of the thin film apparatus. A piezoelectric signal was generated from a sample that was produced via the sol-gel spin coating method with a reinforcing layer of a piezoelectric polymer, polyvinylidene fluoride.