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Acoustic and Piezoelectric Properties of 0–3 Connectivity Environmental-Friendly Lead-Free BCTS–Portland Cement Composites

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New environmental-friendly lead-free barium calcium stannate titanate (BCTS)–Portland cement (PC) composites were studied and fabricated to be compatible with the concrete structures for sensors and smart-structure health-monitoring applications. The lead-free composites were produced by pressing and curing techniques. The effect and optimum of BCTS content on properties of composites were studied and compared with models. The acoustic impedances of composites within a range of 30 to 50% BCTS contents are optimal for an acoustic matching with concrete and give good compatibility with concrete structure. Scanning electron microscope images showed calcium silicate hydrate (the main hydration product of cement) at interfacial zone and cement matrix. The piezoelectric results indicate that the BCTS ceramic can improve the electromechanical coupling and piezoelectric properties in these composites. The piezoelectric coefficient measurements followed the cube model.

Keywords: lead-free composites, BCTS, Portland cement, acoustic impedance, piezoelectric properties.