

Study of Bonding Utilizing Cold Sintering for Ceramic Adhesives for High-temperature Applicable Energy Harvesting Piezoelectric Device

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In this study, we introduce a new bonding technique that enables the joining of different materials at low temperatures and provides a bond superior to that of polymer adhesives at high temperatures, in the temperature range of 250°C to 500°C. This technique involves a low temperature sintering process that is termed “Cold Sintering Process”, where a dielectric composite powder material is sintered to function as the adhesive between two other materials being bonded. In order to characterize and further discuss the potential of this new bonding methodology, which we call Cold Sintering Ceramic Bonding (CSCB), we consider some initial mechanical characteristics, including four-point bending, micro-indentation, and adhesion pull tests. Where appropriate, we compare mechanical properties against low and high temperature epoxies, and demonstrate that the CSCB matches up competitively with the epoxies in the low temperatures and remains strong at temperatures well above those where standard polymer adhesives fail. These promising results were useful in tailoring CSCB to achieve the high temperature application goal. The detail high temperature mechanical and electrical properties are elaborated upon in this report.