Microelectronic Ceramic Integration Technology at Low Temperature

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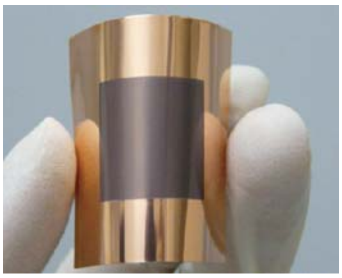
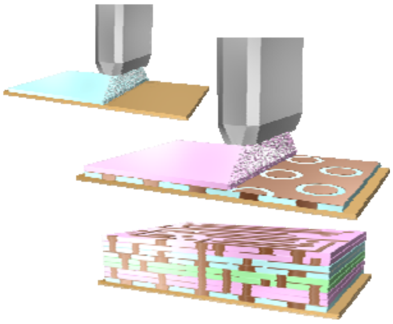
Currently, thin electrical element modules are needed to achieve the miniaturization and multifunction capabilities of mobile terminals such as smartphones, tablet PCs, and so forth. Accordingly, passive integration, including energy-generation devices using thermoelectricity and energy storage such as solid-state lithium ion batteries in a single-module package, is of demand. This demand has expanded to include the R&D of flexible and stretchable electronics.

Passive components may consist of ceramics such as $BaTiO_3$, Al_2O_3, ZnO, Li compounds, and so on, and metal for wiring. Because ceramics generally require firing at temperatures >1000 °C, it is difficult to incorporate ceramics with low resistivity and low-melting-point metals, such as Cu with a melting point of 1083 °C, and to embed them in a resin package or sheet.

In this study, we demonstrate that dense, thick, and organic binder- free ceramic green-state film made of stress-free nanoparticles can be obtained at room temperature by making use of the unstable and high-surface energy amorphous phase on the surface of the particles produced in the deposition process for bonding the nanoparticles[1]. By revising the deposition method, we succeeded in forming a multilayered structure consisting of nanoparticulated dense and stress-free ceramic thick film on Cu foil at room temperature. We also verified that the ceramic film can be densified at low temperatures, and coannealed and integrated with different ceramic films and Cu wiring [2, 3]. Because the green-state ceramic film produced at room temperature has apparently excellent electrical properties, the electrical circuit with passive ceramic elements can be constructed on polymer sheets for flexible electronics applications.





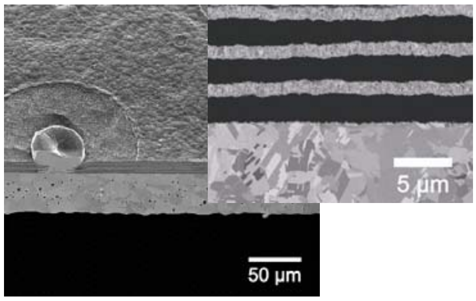


Figure 1 (left) Ceramic Capacitor formed on Polyimide sheet.
Figure 2 (middle) Developed Novel Multilayered Ceramic Integration Process.
Figure 3 (right) Cross-sectional View of Prototype of Multilayered Ceramic Capacitor on Cu Foil.

Reference

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