

# Deposition of a High-K Ceramic Film on a Resin Substrate at Room Temperature

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## Abstract

Miniaturization, multi-functionality and cost reduction are required for electronic devices such as cellular phones and personal computers. Microelectronics packaging and substrate technology are considered to be the important core technologies to satisfy these demands. To miniaturize the substrate, it is necessary to reduce the number of surface-mounted passive components such as ceramic condensers, and integrate the components in a monolithic module. For cost reduction, the use of low-cost polymer printed wiring boards (PWB) is effective. A PWB-embedded condenser consisting of a ceramic material with a high dielectric constant enables high integration (Figure 1). Fujitsu has developed a technology for the room-temperature deposition of a ceramic film with a high dielectric constant, to create a resin substrate with ceramic passive functions such as condenser, microwave filter and so forth. Research for the new technology was conducted in collaboration with the National Institute of Advanced Industrial Science and Technology (AIST) of Japan.

## Technology

Embedding ceramic condensers manufactured at around 1000°C into the PWB is difficult, since the maximum temperature a PWB can tolerate is around 300°C. We perform ceramic film ( $\text{BaTiO}_3$ ) deposition on a PWB at room temperature by using an aerosol so that the ceramic film is formed by bombarding the PWB with ceramic particles delivered through a nozzle by gas pressure. We have obtained a ceramic film with a dielectric constant of as much as 400, deposited at room temperature, by controlling the gas flow of an aerosol of specially crafted ceramic crystal particles. We have produced a three-layer ceramic condenser with a maximum capacitance density of 300 nF/cm<sup>2</sup> on a PWB (Figure 2).

## Application Examples

This technology can involve various passive components besides condensers, contributing to multi-functionality, miniaturization, high-speed transmission, and cost reduction of the following electronic devices, ubiquitous in networking.

- PWB and microelectronics packaged with embedded condensers
- Microwave modules integrating various passive ceramic components (filters, antennas, etc.)
- Integrated multi-functional microwave electronic components

In addition, we will promote research and development on the room-temperature deposition of ceramic films with higher dielectric constants and continue to study ceramic films with characteristics ideal for a variety of applications.

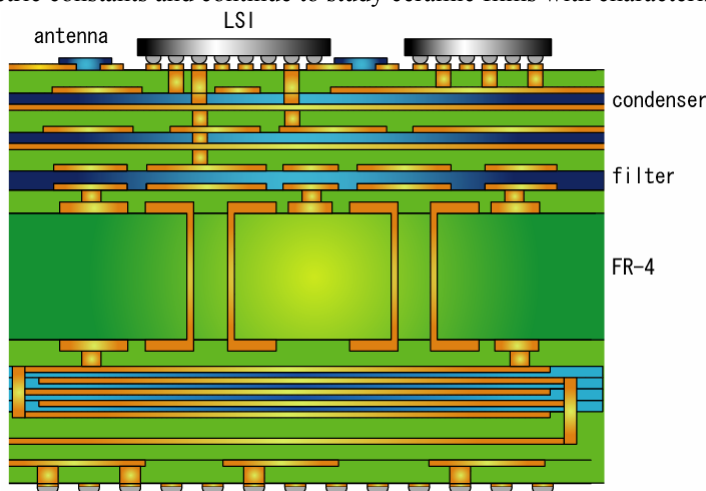


Figure 1. Schematic image of resin substrate embedding various passive elements

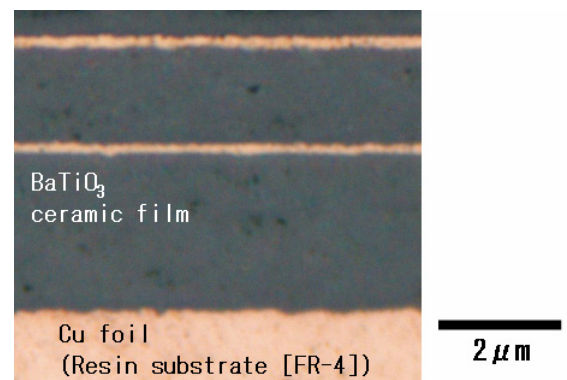


Figure 2. Cross-sectional view of multilayer condenser formed on resin substrate (FR-4)