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"Technology for miniaturizing and capacity-expanding MLCCs" The key is ultra-fine materials! The reason for developing materials on one's own

With the miniaturization and performance enhancement of electronic devices, performance demands for multilayer ceramic capacitors (MLCCs) have been rising. Smaller but larger capacitance — How to respond to contradictory requirements? This issue will describe material technology that realizes miniaturization and capacitance expansion, as well as the MLCC production process.

01 Basic structure and production process for MLCCs

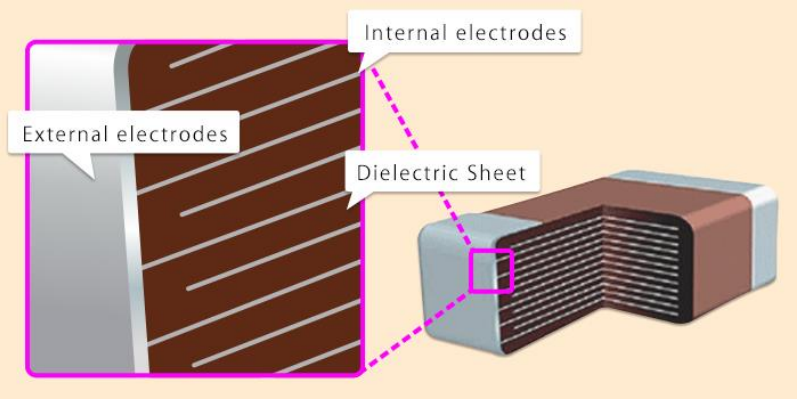
MLCCs with growing requirements for use in IoT, 5G, Advanced Driver-Assistance Systems (ADAS), with constant requests for performance enhancement

A high-end smartphone contains 1,000 or more MLCCs, and this number is expected to grow along with performance enhancement. Miniaturization without reducing capacitance (amount of electric charge that can be stored) has also been requested. In other words, larger capacitance with the same size, and smaller dimensions with the same capacitance are required for MLCCs.

How are MLCCs miniaturized? The key is ultra-fine materials. Before this, to deepen understanding, we will look at the basic structure of an MLCC and its production process.

<Basic Structure>

As its name indicates, a Multilayer Ceramic Capacitor (MLCC) has a layered structure with ceramic dielectric and internal electrodes, one on top of the other.

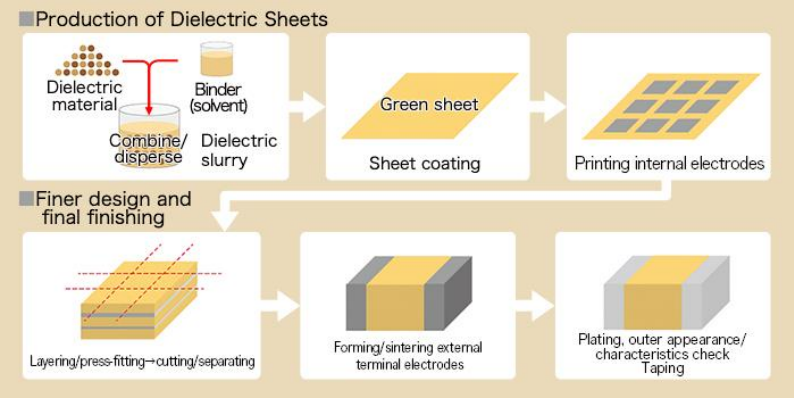


▲Cross-section of an MLCC and its Layered Structure

The lineup of TAIYO YUDEN's MLCC range, from the miniature size of 0.25 (vertical) x 0.125 (horizontal) x 0.125 mm (height) to the largest capacity in the industry of 1,000µF (4.5 (vertical) x 3.2 (horizontal) x 3.2 mm (height)). These products have been realized with the technology for precisely layering thin dielectric sheets (less than 1µm, or 1/100 of the thickness of a human hair) (up to 1,000 layers or more).

<Production Process>

The MLCC production process consists of material, printing, and layering technologies.

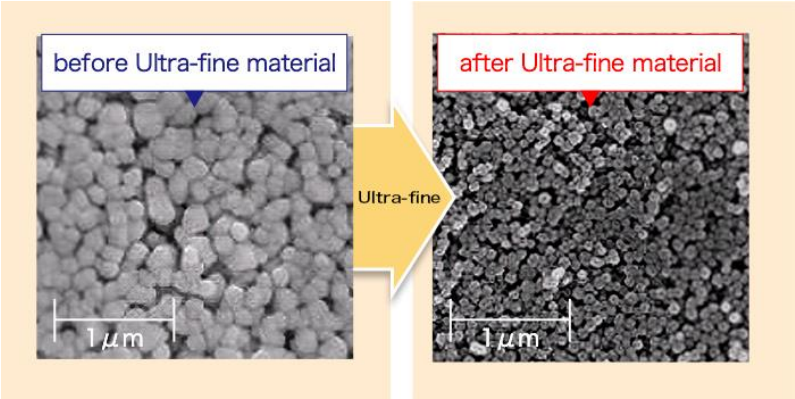


▲Schematic of the MLCC Production Process

It is possible to increase the capacity of an MLCC by layering more dielectric sheets. However, the thickness will increase. To obtain both large capacity and small size, thinner, high-quality dielectric sheets are required. Ultra-fine material technology enables such thin sheets.

02 Ultra-fine material, a key to miniaturization and performance enhancement

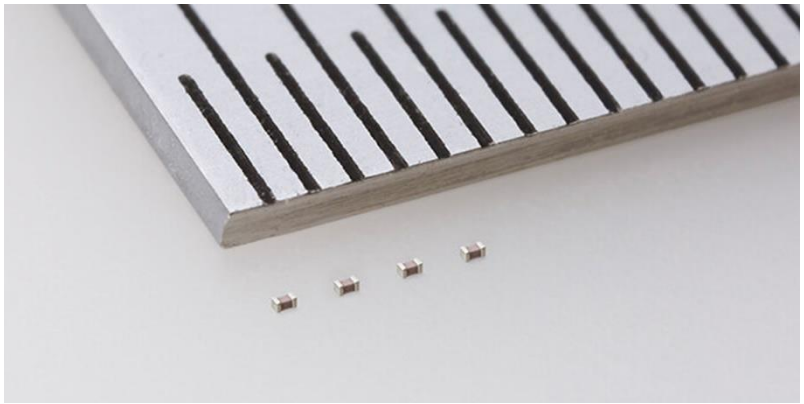
Ultra-fine material is created from nano-level small particles of dielectric ceramic, which is an important technology affecting the following processes and quality.



▲Ultra-fine and non-ultra-fine particles
The former have a higher density.

Ultra-fine particles are not just small particles, but require the technology to make particle sizes uniform. Uneven particle sizes reduce capacitance due to insufficient density, or make it difficult to maintain even thickness of the dielectric sheet. If there is unevenness in the sheet, the required reference performance cannot be attained.

Even if the thickness of a single sheet is 1µm, layering 1,000 or more sheets will accumulate errors. Manufacturers are working hard to realize an ultra-fine material with high precision, which is the key factor for performance and quality.



▲Smallest MLCC from TAIYO YUDEN
Ultra-fine material realized in such a small size (0.25 (vertical) x 0.125 (horizontal) x 0.125 mm (height)).

03 The reason for developing materials on one's own

TAIYO YUDEN is developing products that respond to market needs by refining its elemental technologies since establishment in the entire process, from material development to commercialization, to create electronic components that contribute to the evolution of electronic devices.
We will continue enhancing our material technology to satisfy the various needs of the market and customers.

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