

What is a multilayer ceramic capacitor?

The multilayer ceramic capacitor (MLCC), which is one of them, is the most significant passive element capable of storing and releasing electrical charge. For resonant circuit applications, MLCCs provide excellent stability and low losses, as well as great volumetric efficiency for buffer, by-pass, and coupling applications [5,9,10,11].

What is functionally graded multilayer ceramic capacitor (MLCC)?

In this study, we fabricated the functionally graded multilayer ceramic capacitor (MLCC) with enhanced temperature stability in the dielectric response and high tunability. To fabricate the compositionally graded MLCC, various compositions given as  $\text{BT} (1-x) \text{S} x -\text{BCN} (0.01 \leq x \leq 0.08)$  were used.

How have multilayer ceramic capacitors changed in recent years?

In recent years, multilayer ceramic capacitors have become increasingly smaller and their capacitance has increased while their fabrication processes have been improved; for instance, the dielectric layers have become thinner and the precision with which the layers are stacked has been enhanced. Person in charge: Murata Manufacturing Co., Ltd. Y.G

What is the energy density of lead-free multilayer ceramic capacitors?

A large energy density of  $20.0 \text{ J/cm}^3$  along with a high efficiency of 86.5%, and remarkable high-temperature stability, are achieved in lead-free multilayer ceramic capacitors.

Which ceramics were selected for the compositionally graded multilayer ceramic capacitor?

$0.975\text{BaTi}_{1-x}\text{Sn}_x\text{O}_3 - 0.025\text{Ba}(\text{Cu}^{1/3}\text{Nb}^{2/3})\text{O}_3$  (BTS-BCN) ceramics were selected for the compositionally graded multilayer ceramic capacitor because Curie temperature of this composition can be easily tuned by modulating Sn content while maintaining high permittivity and low loss in wide temperature range [32,37].

Why do we need a tunability of capacitance in multilayer ceramic capacitors?

The temperature stability and electric field tunability of capacitance in multilayer ceramic capacitors (MLCCs) is highly desired to develop smaller and lighter power electronic devices. The tunability in capacitance over wide range of frequency and power provides opportunity to develop new circuit architectures.

Developing metal ion hybrid capacitors (MIHCs) that integrate both battery-type and capacitor-type electrode materials is acknowledged as a viable approach towards achieving electrochemical energy storage devices characterized by high energy power density and extended cycle life [17], [18], [19] 2001, Amatucci et al. [15] pioneered the lithium-ion ...

Multilayer ceramic capacitors, or MLCCs, come in the form of blocks with a specific amount of stacked

