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# BST Thin Film Multi-Layer Capacitors

**Woo Sung Choi[1,2], Min-Gyu Kang[1], Byeong-Kwon Ju[2], Seok-Jin Yoon[3], Chong-Yun Kang[1,4]***

[1]Electronic Materials Research Center, Korea Institute of Science and Technology, Seoul 136-791, [2]Display and Nanosystem Laboratory, College of Engineering, Korea University, Seoul 136-713, [3]Research Planning & Coordination Division, Korea Institute of Science and Technology, Seoul 136-791, [4]KU-KIST Graduate School of Converging Science and Technology, Korea University, Seoul 136-713, Korea

Even though the fabrication methods of metal oxide based thin film capacitor have been well established such as RF sputtering, Sol-gel, metal organic chemical vapor deposition (MOCVD), ion beam assisted deposition (IBAD) and pulsed laser deposition (PLD), an applicable capacitor of printed circuit board (PCB) has not realized yet by these methods. Barium Strontium Titanate (BST) and other high-k ceramic oxides are important materials used in integrated passive devices, multi-chip modules (MCM), high-density interconnect, and chip-scale packaging. Thin film multi-layer technology is strongly demanded for having high capacitance (120 nF/mm$^2$). In this study, we suggest novel multi-layer thin film capacitor design and fabrication technology utilized by plasma assisted deposition and photolithography processes. Ba0.6Sr0.4TiO3 (BST) was used for the dielectric material since it has high dielectric constant and low dielectric loss. 5-layered BST and Pt thin films with multi-layer sandwich structures were formed on Pt/Ti/$SiO_2$/Si substrate by RF-magnetron sputtering and DC-sputtering. Pt electrodes and BST layers were patterned to reveal internal electrodes by photolithography. SiO2 passivation layer was deposited by plasma-enhanced chemical vapor deposition (PE-CVD). The passivation layer plays an important role to prevent short connection between the electrodes. It was patterned to create holes for the connection between internal electrodes and external electrodes by reactive-ion etching (RIE). External contact pads were formed by Pt electrodes. The microstructure and dielectric characteristics of the capacitors were investigated by scanning electron microscopy (SEM) and impedance analyzer, respectively. In conclusion, the 0402 sized thin film multi-layer capacitors have been demonstrated, which have capacitance of 10 nF. They are expected to be used for decoupling purpose and have been fabricated with high yield.

**Keywords:** Thin film, Capacitor, Multi-layer, BST