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$CaCu_3Ru_4O_{12}/CaCu_3Ti_4O_{12}/CaCu_3Ru_4O_{12}$ FUNCTIONALLY GRADED ELECTRONIC CERAMICS

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Materials exhibiting a high dielectric constant with low sensitivity to temperature variation have great technological significance. Recently, the colossal permittivity of ~10^4–10^5 in the kilohertz region at room temperature, and good stability over the temperature range from 100 to 600 K was discovered for compounds of general formula $AC_3B_4O_{12}$, where $CaCu_3Ti_4O_{12}$ (CCTO) has remarkable interest. However, it was found that CCTO ceramic-electrode interfaces have an impact on electrical properties; actually, energy barriers could be induced by low ceramic-electrode contact resulting in the decrease of permittivity. The ceramic-electrode contact problem could be solved by introducing interlayer material with crystal structure and close lattice parameters as CCTO and with metallic cation (at B position) as it'll be further used for electrode. In this work, materials used for preparation of electronic ceramics were CCTO and $CaCu_3Ru_4O_{12}$ (CCRO). The role of CCRO was to decrease the strains at the CCTO-electrode interfaces. CCTO and CCRO powders were prepared by precipitation, and successive calcinations to obtained single phased materials. The synthesized powders were characterized by XRD, FE–SEM and TEM techniques. The sinterability of CCTO and CCRO powders was investigated by heating microscopy. Powders were uniaxially pressed into pellets (ø 6 mm) and sintered up to 1100 ^oC, with 2, 5, 10 and 20 ^{o}/min. The recorded densification curves were used for: (1) estimation of linear coefficient of thermal expansion (CTE), and furthermore, (2) for choosing sintering conditions for fabrication of functionally graded CCRO/CCTO/CCRO ceramics. The microstructure of prepared FGMs was examined by FE–SEM method. The electrical properties of FGMs were investigated in medium frequency (MF) and microwave (MW) regions. For the MF measurements, Au electrodes were deposited at CCRO surfaces of FGMs. Measurements were done in frequency interval 42 Hz – 5 MHz, in air atmosphere, during cooling from 400 to 25 °C; an applied *ac* voltage was 1 V. The resonance measurements in the 10 MHz – 67 GHz range were done in a conventional set up (without electrodes). Electrical properties of the FGMs were correlated to the microstructure and sample–electrode interfaces.