J Material Sci Eng 2017, 6:4(Suppl)
DOI: 10.4172/2169-0022-C1-071

The dielectric constant of $CaCu_3Ti_4O_{12}$ ceramics

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After the discovery of a gaint permittivity in $CaCu_3Ti_4O_{12}$ by Subramanian et al. in 2000, extensive investigations to explore the origin have been performed in recent years. $CaCu_3Ti_4O_{12}$ is a perovskite-like compound with a dielectric constant up to 105, which is almost temperature independent from 100 K to 400 K and shows neither ferroelectric phase nor crystallographic structural transition. These unusual properties are very valuable for practical applications. However, the source of the giant dielectrical constant is not clear. In this work, the dielectric properties of $CaCu_3Ti_4O_{12}$ ceramics were studied using AC and DC electrical measuring methods in order to understand the origin of the colossal dielectric constant, including impedance spectra analysis, frequency and temperature spectrum, electrical conditioning treatment and capacitance – biased voltage curves measuring. The experimental results indicate that the constant is very strongly correlated with defects in $CaCu_3Ti_4O_{12}$, especially oxygen vacancy, which is the main contribution for the dielectric polarization at low frequencies and high temperatures.

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Effects of walnut shell dusts and boron powders on evaluation of the friction and wear characteristics of the asbestos free brake pads

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Brake pads are the most important component of the automobile braking system. The use of asbestos fiber is being avoided due to its carcinogenic nature that might cause health risks. In the present investigation, the brake pads were produced by varying (wt.%) constituents of the existing composition and new formulations were made with other friction materials. In this study, a new brake pad produced using walnut shell dusts and boron powders to replace petroleum coke and asbestos were investigated, respectively. Two sets of brake pads with 3.5 and 7% ratio walnut shell and boron dusts were produced using compressive molding. The brake pad samples were put in the water and oil for 24 hours. The physical, mechanical and tribological properties of the walnut shell dusts and boron powders based brake pads were evaluated and compared with the values for the commercial brake pads. Afterward, hardness was measured with Shore D device. The weight changes were measured by an assay balance. The brake pads with walnut pads were heavier than the brake pads with boron powders. The compressibility and shearing tests were performed according to the ISO 6310 and 6312 standards, respectively. Several mechanical and tribological properties were tested for tailored frictional samples, including hardness, friction coefficient (COF) and wear rate, while the details and changes of the friction surfaces were studied by using a scanning electron microscopy (SEM) and an energy dispersive X-ray microanalysis (EDX) spectrum. In future, the brake pad samples will be evaluated on a pin on disk following the procedure in an American automobile testing standard in the coming period.

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