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Study on Colossal Dielectric Constant Mechanism of Al/Nb Co-doped CCTO by PAT

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Calcium copper titanate ceramics colossal dielectric constant mechanism is studied by changing its microstructure through co-doping different concentrations of Al/Nb on its Ti4+ sites (CaCu3Ti4-x Al0.5xNb0.5x O12, x=0.2%, 0.5%, 5%). We mainly use positron annihilation technique(PAT), combined with scanning electron microcopy(SEM) and complex impedance spectroscopy(IS), to explore the influence of microstructure on samples dielectric properties. SEM results show that the grain boundary of each sample has a pulpy appearance, and it is hardly for SEM to determine its thickness. However PAT is sensitive to the vacancy type defects trapped by grain boundaries, and can be used to characterize samples grain boundaries microstructure. The variation of coincident Doppler broadening spectra S parameters of samples with different co-doping concentration is consistent with the changing trend of their annihilation mean lifetimes, and the x=0.5% co-doped sample has the smallest S and mean lifetime which implies the thinnest thickness of grain boundary[1]. So the sample with x=0.5% has the highest dielectric constant according to the internal barrier layer capacitance (IBLC) model[2]. Experiment results support the prediction of IBLC model, which describe the colossal dielectric constant mechanism of calcium copper titanate ceramics.

Primary authors: WEN, Ali; Prof. ZHU, Jiliang (Sichaun University); Mr FAN, Ping (China Institute of Atomic Energy); Mr MA, Hailiang (China Institute of Atomic Energy); Mr ZUO, Yi (China Institute of Atomic Energy); Mrs ZHANG, Qiaoli (China Institute of Atomic Energy); Prof. YUAN, Daqing (China Institute of Atomic Energy)

Presenter: WEN, Ali

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