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Effects of Oxygen Vacancies on Dielectric Properties of $Na_{1/2}Bi_{1/2}Cu_3Ti_4O_{12}$ Ceramics Prepared by a Urea Combustion Method

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The influences of oxygen vacancies on the dielectric and electrical properties of $Na_{1/2}Bi_{1/2}Cu_3Ti_4O_{12}$ ceramics prepared by a urea combustion method were investigated via annealing in oxidizing atmosphere. Interestingly, a single $Na_{1/2}Bi_{1/2}Cu_3Ti_4O_{12}$ phase was successfully prepared using a low calcination temperature of 800 °C for 6 h. High dielectric permittivity (ε') and dense ceramic microstructure were achieved by sintering at a low temperature of 980 °C. The values of ε' and tanδ were reduced by annealing in O_2 atmosphere, which were described to correlate with the decrease in oxygen vacancies at grain boundaries. A decrease in low-frequency tan δ values can be well explained due to the reduction of DC conduction, which was primarily governed by the enhanced grain boundary resistance due to filling oxygen vacancies. A slight decrease in ε' due to the annealing process was attributed to the reduction of grain boundary capacitance. By annealing process, the conduction activation energy at the grain boundaries was significantly enhanced, whereas the conduction activation energy inside the grains did not change. The results clearly indicated the effects of oxygen vacancies at the grain boundaries on the giant dielectric response and correlated grain boundary response.

Primary author: Mr TUICHAI, Wattana (Materials Science and Nanotechnology Program, Faculty of Science, Khon Kaen University, Khon Kaen, THAILAND 40002)

Co-authors: Dr THONGBAI, Prasit (Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen, THAILAND 40002); Prof. MAENSIRID, Santi (School of Physics, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, THAILAND 30000); Dr DANWITTAYAKUL, Supamas (National Metal and Materials Technology Center (MTEC), Thailand Science Park, Pathumthani, THAILAND 12120); Dr YAMWONG, Teerapon (National Metal and Materials Technology Center (MTEC), Thailand Science Park, Pathumthani, THAILAND 12120)

Presenter: Mr TUICHAI, Wattana (Materials Science and Nanotechnology Program, Faculty of Science, Khon Kaen University, Khon Kaen, THAILAND 40002)

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