HIGH TEMPERATURE X-RAY DIFFRACTION STUDY OF REACTION RATES IN CERAMICS

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The effect of initial batch particle size on phase formation of Aurivillius phases, such as $Bi_2Sr_2Nb_2TiO_{12}$, $Bi_2Sr_2Nb_2AlO_{11.5}$ and $Bi_2Sr_2Ta_2AlO_{11.5}$, was studied using in-situ high temperature x-ray diffraction (HTXRD). These phases have applications as electrically active materials for a variety of electrochemical and ferroelectric applications. Reaction kinetics, as well as reaction mechanisms, were investigated. Current research has shown that in order to make phase pure materials via solid-state synthesis, over 100 hours of heat treatment is necessary. Decreasing the initial particle size, and thereby promoting faster reactions at lower temperatures, decreased treatment times. HTXRD was utilized up to two days in order to obtain reaction kinetics, and quenched samples were used for longer heat treatment. The reaction mechanisms and kinetics determined during the study allowed a critical review of certain PDF data, and suggested corrections. Phase purity is in question for PDF cards 50-0498 and 50-0499, identifying $Bi_2Sr_2Nb_2AlO_{11.5}$ and $Bi_2Sr_2Ta_2AlO_{11.5}$. Three distinct phases were found present in polished samples investigated using back-scattered electron imaging.