The mechanism of combustion and phase formation in the BaO2-TiO2-organic compound system

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1. Introduction

The studies of barium titanate (BaTiO3) and its related compounds have intensified because of their excellent electric and electromechanical properties, such that, they are extensively used in the preparation of high-permittivity capacitors, PTC resistors, transducers, and ferroelectric memories. Barium titanate powders has been synthesized by the variety of methods, including sol-gel synthesis, hydrothermal synthesis, metal organic chemical vapor deposition, sputtering, electrothermal methods, Self-propagating High-temperature Synthesis (SHS). In this work, the influences of certain organic compounds on the mechanism of combustion and phase formation of the BaO2-TiO2 system have been studied.

2. Experimental and results

The combustion of reaction mixtures was carried out in a constant pressure reactor in argon atmosphere of 0.5 MPa. The initial mixture was preliminary stamped into the cylindrical stainless steel mould with the 2 mm thickness, 30mm diameter and 40mm in height. Experimental densities of samples were 1.9-2.1 g/cm3. Barium peroxide powders with particle size less than 45 mm (95 % purity, Aldrich Chemical Co., USA); titanium dioxide: anatase (98 % purity, Hankook Titanium Co., Korea) with the particle size 1-2 mm; urea, hexamethylenetetramine (both chemical pure, Aldrich Chemical Co., USA) grinded up to particle size less than 10 mm, were used in the experiments. The maximum combustion temperatures (Tc) and temperature distribution in the combustion wave were measured by tungsten - rhenium thermocouples (W-5 %/Re vs W-20 %/Re) 100 mm in diameter previously covered with alumina thin layer and embedded in the centre of the sample at predefined distances from each other. The phase composition of the combustion products was determined by X-ray diffractometer (XRD; Siemens 5000). The morphology of initial mixture and products were observed using Scanning Electron Microscope (SEM; JSM 5410) equipped with Energy Dispersive X-ray Spectroscopy (EDS; Oxford ISIS 300). The optimal conditions of tetragonal BaTiO3 powder synthesis with the spherical form and particles size 2-5 mm were found.