

Efek rasio diameter transduser dan reaktor pada proses pembentukan nanopartikel Ba_{0.7}Sr_{0.3}TiO₃ dan Ba_{0.3}Sr_{0.7}TiO₃ melalui destruksi ultrasonik = The effect of transducer and reactor diameter ratio in the formation of Ba_{0.7}Sr_{0.3}TiO₃ and Ba_{0.3}Sr_{0.7}TiO₃ nanoparticles by ultrasonic destruction / Agam Aidil Fahmi

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Abstrak

ABSTRAK

Karya tulis ini melaporkan hasil proses pembentukan nanopartikel Ba_{0.7}Sr_{0.3}TiO₃ dan Ba_{0.3}Sr_{0.7}TiO₃ melalui pemaduan mekanik dan destruksi ultrasonik daya tinggi. Proses destruksi ultrasonik dilaksanakan dalam 3 kondisi berbeda yaitu menggunakan variasi rasio diameter transduser dan reaktor 1:1.4, 1:1.6, dan 1:1.8 terhadap media mengandung partikel konsentrasi 3.0 gr/l selama waktu destruksi 3 jam. Secara spesifik, tujuan dari penelitian ini adalah mempelajari efek rasio diameter transduser dan diameter reaktor (dt/Dr) terhadap pembentukan nanopartikel Ba_{0.7}Sr_{0.3}TiO₃ dan Ba_{0.3}Sr_{0.7}TiO₃. Karakterisasi partikel yang diperoleh menggunakan XRD, PSA, dan SEM. Hasil identifikasi fasa material dari evaluasi difraksi sinar X memastikan bahwa material Ba_{0.7}Sr_{0.3}TiO₃ dan Ba_{0.3}Sr_{0.7}TiO₃ adalah material berfasa tunggal dan destruksi ultrasonik tidak menyebabkan perubahan fasa material. Kedua material berbeda dalam ukuran rata-rata partikel sebelum destruksi ultrasonik yaitu 538 nm untuk partikel Ba_{0.7}Sr_{0.3}TiO₃ dan 480 nm untuk partikel Ba_{0.3}Sr_{0.7}TiO₃. Kedua nilai ukuran rata-rata partikel ini mengalami penurunan selama proses destruksi ultrasonik. Namun, ukuran partikel terkecil masing-masing material adalah 38 nm dan 24 nm diperoleh pasca destruksi dengan (dt/Dr) adalah 1.8. Ukuran rata-rata partikel ini hampir sama dengan ukuran rata kristalinitnya masing-masing 22 nm dan 14 nm. Dengan demikian hanya terdapat 1 kristalit dalam masing-masing partikel. Dapat disimpulkan bahwa nanopartikel baik material Ba_{0.7}Sr_{0.3}TiO₃ maupun Ba_{0.3}Sr_{0.7}TiO₃ dapat dihasilkan dari dua tahapan proses yaitu tahapan sintesis dengan pemaduan mekanik dan tahapan destruksi dengan metode destruksi ultrasonik daya tinggi. Partikel monokristalit Ba_{0.7}Sr_{0.3}TiO₃ dengan ukuran 38 nm dan Ba_{0.3}Sr_{0.7}TiO₃ dengan ukuran 24 nm telah dihasilkan dari destruksi ultrasonik menggunakan parameter proses (dt/Dr) 1.8 dalam durasi destruksi selama 3 jam.

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ABSTRACT

We report results of research on the formation of Ba_{0.7}Sr_{0.3}TiO₃ and Ba_{0.3}Sr_{0.7}TiO₃ nanoparticles through the mechanical alloying process and followed by high power ultrasonic destruction. Ultrasonic destruction process carried out in three different modes of the transducer and reactor diameter ratios respectively 1:1.4, 1:1.6, and 1:1.8 against the media containing particles of 3.0 g/l concentration during 3 hours destruction time. The specific goal of this work was to study the effect of transducer and reactor diameter ratio (dt/Dr) on the formation of Ba_{0.7}Sr_{0.3}TiO₃ and Ba_{0.3}Sr_{0.7}TiO₃ nanoparticles. Particle characterizations were carried out under the employment of XRD, PSA, and SEM. Results of material phase identification by XRD ensure that the synthesized Ba_{0.7}Sr_{0.3}TiO₃ and Ba_{0.3}Sr_{0.7}TiO₃ material are both single phase. In addition, the ultrasonic destruction to the particle materials did not cause the phase change. Prior to ultrasonic destruction, the two materials are different in their average particle size in which

$\text{Ba}_{0.7}\text{Sr}_{0.3}\text{TiO}_3$ and $\text{Ba}_{0.3}\text{Sr}_{0.7}\text{TiO}_3$ respectively has particles with mean sizes 538 nm and 480 nm. The average value for both particles was decreased during ultrasonic destruction. However, the smallest mean particle size of each material was 38 nm and 24 nm which were obtained after the ultrasonic destruction by (dt/Dr) of 1.8. These average sizes are almost equal to the average size of their crystallites which are respectively 22 nm and 14 nm. Thus there is only one crystallite within each particle. It can be concluded that both $\text{Ba}_{0.7}\text{Sr}_{0.3}\text{TiO}_3$ and $\text{Ba}_{0.3}\text{Sr}_{0.7}\text{TiO}_3$ nanoparticles can be produced by a two-stage process. The first stage is a phase formation by mechanical alloying and the formation of $\text{Ba}_{0.7}\text{Sr}_{0.3}\text{TiO}_3$ and $\text{Ba}_{0.3}\text{Sr}_{0.7}\text{TiO}_3$ nanoparticle obtained in the second stage in which the particle sizes were further reduced by the high power ultrasonic destruction. Single crystallite particles with a mean size of 38 nm for $\text{Ba}_{0.7}\text{Sr}_{0.3}\text{TiO}_3$ and that of 24 nm for $\text{Ba}_{0.3}\text{Sr}_{0.7}\text{TiO}_3$ have been successively obtained by ultrasonic destruction process with a parameter (dt/Dr) of 1.8 within 3 hours destruction time.