

## STUDI SINTESIS BAHAN YSZ (*Yttria Stabilized Zirconia*, $Y_2O_3-ZrO_2$ ) MELALUI PEMADUAN DENGAN PROSES ULTRASONIK

### ABSTRAK

Telah dilakukan studi sintesis bahan YSZ (*Yttria Stabilized Zirconia*,  $Y_2O_3-ZrO_2$ ) melalui pemaduan dengan proses ultrasonik. Untuk mendapatkan perbandingan analisis, dilakukan juga sintesis bahan YSZ dengan *high energy ball milling* dan penggerusan. Komposisi kimia dari  $Y_2O_3:ZrO_2$  adalah 4,5% mol:95,5% mol (4,5YSZ) dan 8,0% mol:92% mol (8YSZ). Serbuk yttria dan zirkonia berukuran nano ditambahkan dengan toulene cairan dan kemudian dipadukan dengan menggunakan *ultrasonic probe* dengan frekuensi 20 kHz dan amplitudo 39% selama 10 dan 40 jam. Setelah itu, serbuk hasil pemaduan dikalsinasi pada temperatur 500°C selama 3 jam dan dikompaksi pada tekanan ~100 Mpa, kemudian disintering pada temperatur 1.400°C selama 3 jam. Karakterisasi berturut-turut dilakukan dengan menggunakan XRD (*X-ray Diffraction*) spektroskop, SEM-EDS (*Scanning Electron Microscope-Energi dispersif X-ray spektroskop*) dan LCR (*Induktansi, Kapasitansi dan Resistance*) meter. Hasil penelitian menunjukkan bahwa serbuk hasil pemaduan cukup homogen dengan proses ultrasonik meskipun fasa YSZ belum sepenuhnya terbentuk untuk semua variasi komposisi dan waktu pemaduan. Namun, fasa YSZ telah terbentuk untuk semua sampel pelet YSZ setelah proses sintering meskipun masih teridentifikasi sebagian kecil puncak fasa monoklinik zirkonia. Selain itu, nilai konduktivitas ionik-nya relatif baik. Nilai ini meningkat dengan bertambahnya temperatur dan komposisi yttria sesuai dengan karakteristik ionik pada padatan YSZ. Hasil penelitian menunjukkan bahwa proses ultrasonik untuk memadukan serbuk yttria dan zirkonia dalam sintesis bahan YSZ berpotensi untuk digunakan dan dieksplorasi.

**Kata kunci:** YSZ, yttria, zirkonia, ultrasonik, *high energy ball milling*, penggerusan.

## STUDY ON SYNTHESIS OF YSZ (Yttria Stabilized Zirconia, $Y_2O_3-ZrO_2$ ) MATERIALS BY ULTRASONIC METHOD FOR MIXING PROCESS

### ABSTRACT

The synthesis of YSZ (Yttria Stabilized Zirconia,  $ZrO_2-Y_2O_3$ ) materials by ultrasonic method for mixing process have been done. In order to have comparison analyses, high energy ball milling and grinding methods for mixing process to syntheses of YSZ materials were also done. The chemical compositions of  $Y_2O_3:ZrO_2$  were 4.5 mol%:95.5 mol% (4.5YSZ) and 8.0 mol%:92 mol% (8YSZ). Yttria and zirconia nano-sized powders were added with a liquid toluene and then mixed using ultrasonic probe with a frequency of 20 khz and amplitude of 39% for 10 and 40 hours. Afterward, the mixed powders were calcined at temperature of 500°C for 3 hours, compacted with pressure of ~100 Mpa, and then sintered at temperature of 1,400°C for 3 hours. Characterizations were done using XRD (X-ray Diffraction) Spectroscopy, SEM-EDS (Scanning Electron Microscope-Energy Dispersive X-ray Spectroscopy) and LCR (Inductance, Capacitance and Resistance) meter, respectively. The results showed that the powders were mixed quite homogeneous by ultrasonic method process even though YSZ phase has not been fully formed for all the variation of compositions and mixing times. However, the phase of YSZ has been formed for all the YSZ pellets samples after sintering process although small peaks of monoclinic phase of zirconia were still indicated. Furthermore, the ionic conductivity values were relatively good. The values increased with the increasing of temperature and yttria composition which is related to the characteristics of solid state ionics of YSZ. The results showed that the ultrasonic method to mix of yttria and zirconia powders for synthesizing of YSZ materials is potential to be used and explored.

**Keywords:** YSZ, yttria, zirconia, ultrasonic method, high energy ball milling, grinding,