Abstract

Transparent $MgAl_2O_4$ ceramics have received attention as alternative materials in transparent armor configuration. Comparison of weight and size of traditional glass composite armors, which resist to the same type of ammuniation, the weight and size of transparent armors can be reduced significantly by using transparent $MgAl_2O_4$ ceramics composite armors due to the higher strength and higher hardness than those of traditional glass. Unfortunately, the fabrication of the transparent ceramics requires nano-sized and non-agglomerated particles. This study investigated the fabrication of $MgAl_2O_4$ nanoparticles by precipitation method using urea and hexamethylenetetramine as precipitants. The results showed that the precursor, prepared using chloride salts as starting materials and using urea as a precipitant, consisted of hydrotalcite and amorphous alumina. After calcining at 1100 °C for 2 hours, the precursor decomposed to $MgAl_2O_4$ nanoparticles with particle size of 20-40 nm. In case of using hexamethylenetetramine as a precipitant, the precursors, prepared using chloride salts or nitrate salts as starting materials, were aluminium oxide hydroxide with low crystallinity. After calcining at 1100 °C for 2 hours, the precursors decomposed to corundum, theta-alumina, and magnesium aluminium oxide. Therefore, $MgAl_2O_4$ nanoparticles could not be synthesized by precipitation method using hexamethylenetetramine as the precipitant. However, the phases of the precursors transformed to hydrotalcite and aluminium oxide hydroxide by hydrothermal treatment at 140 °C for 24 hours. The $MgAl_2O_4$ nanoparticles were obtained by calcining the precursors at 1100 °C for 2 hours. The $MgAl_2O_4$ ceramics were fabricated by hotpressing the $MgAl_2O_4$ nanoparticles, prepared using urea as a precipitatnt, at 1800 °C for 2 hours using pressure of 40 MPa. The relative density of the sintered ceramics reached a value of 99.8%. Unfortunately, the sintered $MgAl_2O_4$ ceramics were just translucent. The transmittance of the sintered $MgAl_2O_4$ ceramics was only 0.3-0.5% in the visible region.