Research & Reviews: Journal of Medicinal Chemistry

Extended Abstract
Vol. 7, Iss. 1
2020

In organic Chemistry : 2018 Synthesis of magnesium aluminate composites reinforced with ceramic particulates for grinding applications - Saad Alotaibi

Manoj Mishra
Union Insurance, UAE

This project aimed at investigating the possibility to synthesize magnesium aluminate composite reinforced with ceramics particulates to be used as grinding materials. Generally, magnesium aluminate ($MgAl_2O_4$) is commonly used in the industries as refractories. Due to its high chemical stability, this project aims at broadening the industrial applications of magnesium aluminate to be used as grinding materials. Grinding materials are usually used in finishing the machining of metals parts to give it its final bright luster. This project is designed to increase the hardness of magnesium aluminate by incorporation of hard ceramic particulates such as borides or carbides. Titanium carbide (TiC) was chosen to be the reinforcement of magnesium aluminate matrix. This work targets at synthesizing $MgAl_2O_4$-TiC composite in a high dense form. The target composite will be synthesized by self-propagating high-temperature synthesis (SHS). SHS is an in-situ process that can perform synthesis and sintering in one step. To the best of our knowledge this composite in its dense form does not prepare by SHS. Different factors controlling the physical and mechanical properties of the final object will be investigated. This factors include, grain sizes of the starting materials, pressing load, initial temperature of the reaction, amount of ceramic and metallic additions.

Magnesium aluminate/$MoSi_2$ and magnesium aluminate/Mo_5Si_3 composites were successfully prepared by combustion synthesis with a special emphasis on the thermodynamic of the reactions involved within the process. the method involves loading of a really weak exothermic formation reaction of $MgAl_2O_4$ onto a highly exothermic formation reaction of $MoSi_2$ and Mo_5Si_3. The starting material was a mix of MoO_3, SiO_2, Al and MgO. The effect of Al grain size (−5 to −71 μm), MoO_3 stoichiometric value (0.7–1.25x), MgO additions (15–25 wt%) and dealing pressure (50 bar) on the synthesis process were investigated. Microstructure of the combustion products was inspected by SEM. it had been found that using −5 μm grain size Al was necessary for reaction completion. Higher stoichiometric value of MoO_3 was found to be necessary to catch up on its volatilization from the reaction media. Addition of MgO as diluents reduced combustion temperature but unexpectedly it reacted with some amounts of SiO_2 and formed Mg_2SiO_2 phase and Mo_5Si_3 rather than $MoSi_2$. However, increasing the reaction pressure was found to be the foremost effective factor to suppress the MoO_3 volatilization.

The mechanical properties and microstructure of alumina-rich magnesium aluminate spinel/tungsten (14 and 22 vol.% W) composites obtained by hot press at 1650 °C under reducing conditions are investigated. The R-curve for these composites was estimated by the indentation strength method and compared thereupon of the monolithic spinel obtained under similar conditions. Rising R-curve behavior was specially observed within the composites when tungsten content was higher. Other mechanical properties like hardness, toughness, Young's modulus and bending strength, were also determined for both (composites and monolithic magnesium aluminate).

Hybrid aluminum matrix composites (HAMCs) are the second generation of composites that have potential to substitute single reinforced composites thanks to improved properties. This paper investigates the feasibility and viability of developing low cost-high performance hybrid composites for automotive and aerospace applications. Further, the fabrication characteristics and mechanical behavior of HAMCs fabricated by stir casting route have also been reviewed. The optical micrographs of the HAMCs indicate that the reinforcing particles are fairly distributed within the matrix alloy and therefore the porosity levels are found to be acceptable for the casted composites. The density, hardness, tensile behavior and fracture toughness of those composites are found to be either comparable or superior to the ceramic reinforced composites. it's been observed from the literature that the direct strengthening of composites occurs thanks to the presence of hard ceramic phase, while the indirect strengthening arises from the thermal mismatch between the matrix alloy and reinforcing phase during solidification.

Aluminum oxide (Al_2O_3), also referred to as alumina, springs from a natural ore called bauxite. Natural Al_2O_3 occurs because the mineral corundum and in its gemstone forms as sapphire and ruby; however, the term alumina usually refers to the manufactured material. The Bayer process was first developed in 1888, and wont to extract most alumina from bauxite. Crushed bauxite is mixed with caustic soda solution and seeded with crystals to precipitate aluminium hydroxide . A kiln is employed to heat the hydroxide, so as to get rid of water. Alumina goes through several transition phases (α, χ, η, δ, κ, θ, γ, ρ) because the temperature increases. the foremost thermodynamically stable form reached at the very best temperatures is that the alpha (α) phase. With its closely packed, hexagonal crystals, this phase is that the strongest.

This work is partly on 24th Global Organic & Inorganic Chemistry Conference on July 18-19, 2018 held at Atlanta, USA