Microstructure and Properties of Ceramic Matrix Composites Fabricated by Powder Injection Moulding

Chuankrerkkul, N.[1], Meepho, M.[2], Chuaon, S.[3] and Pornprasertsuk, R.[4]

[1] Chulalongkorn University, Thailand, [2] Metallurgy and Materials Science Research Institute, Chulalongkorn University, Thailand, [3] Faculty of Science, Chulalongkorn University, Thailand, [4] Center of Excellence in Petrochemical and Materials Technology, Chulalongkorn University, Thailand

Abstract

Powder injection moulding process was employed in this research work for a fabrication of ceramic matrix composites. Powder injection moulding (PIM) is a cost effective near net shape forming technique, especially for mass production of small and complex-shaped components. It can be used for a variety of high performance applications. In this work, two types of powder mixtures were prepared: one was the mixture of nickel oxide-yttria stabilized zirconia (NiO-YSZ) powders and the other was the mixture of alumina and zirconia powders to produce zirconia toughened alumina (ZTA) ceramic specimens. The NiO-YSZ composites were prepared for using as anode in solid oxide fuel cell (SOFC) applications that required about 20-30%porosity while the dense ZTA composites will be used in industrial applications. The binder, used in this study, consists mainly of polyethylene glycol which is a water-soluble ingredient that would subsequently be removed by water leaching prior to sintering of the moulded components. Several sintering cycles were carried out to investigate the effect of sintering temperature on properties of the samples. Microstructure of the sintered specimens were systematically evaluated by scanning electron microscope (SEM). It has been found, for both of the ceramic composites, that sintering temperature strongly affected the strength, hardness as well as density and porosity of the composites. The powder composition also played an important role in microstructure and properties of the specimens. SEM is a very important tool to evaluate the microstructure and pore morphology of the powder injection moulded products.

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