## ABSTRACT

Forsterite ($Mg_2SiO_4$) has the potential for biomedical application. There were various synthesis methods developed over the years to produce nanocrystalline forsterite by conventional pressureless sintering. However, a systematic study on the factors controlling the properties of forsterite during powder processing and sintering has not been established. Hence, the aim of this research is to develop a well-defined phase pure forsterite ceramic employing conventional presureless sintering and to determine the optimum conditions to produce a sintered body with improved mechanical properties. In this study, 3 hours ball milling without heat treatment was determined as the optimum powder preparation method. There were 3 different holding time which were 2 hours (Group 1), 1 hour (Group 2) and 1 minute (Group 3) employed for the conventional pressureless sintering. The studies revealed that the combination of ultrasonic bath, 3 hours ball milling and abstinence of heat treatment proved to be the optimum and energy efficient method because no secondary phase was detected in Group 1 and Group 2 for all temperature range studied (1200°C, 1300°C, 1400°C, 1500°C). The highest Vickers hardness and fracture toughness were recorded in Group 2 at 1500°C with 5.01 GPa and 3.75 $MPam^{1/2}$ respectively. Young's modulus of 90.46 GPa was the highest recorded value for Group 2 at 1400°C. Therefore, Group 2 at 1400°C and 1500°C were the optimal holding time that showed improved mechanical properties even though Group 2 showed more porosity than Group 1 as reflected in the sintered microstructure. The use of higher sintering temperature in Group 1 was the probable cause resulted in lower fracture toughness properties. No sign of liquid phase sintering observed from the quenching experiment.