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On the fabrication of A356/Al_2O_3 metal matrix nanocomposites using rheocasting and squeeze casting techniques

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In the present investigation, A356/Al_2O_3 Al based metal matrix nano-composites (MMNCs) were fabricated using rheocasting technique. Two different sizes of Al_2O_3 nano-particulates were used as reinforcement agent, typically, 60 and 200 nm. Several volume fractions up to 5 vol.-% Al_2O_3 nano-particulates were added to the A356 Al matrix. The MMNCs were fabricated under different rheocasting process parameters such as the melt temperature, stirring speed, stirrer shape, stirrer position…etc. The study of the effect of such parameters on the microstructural characteristics of the MMNCs was evaluated. To reduce the number of experiments required to study the effect of the aforementioned parameters, the design of experiment (DOE) using Taguchi's approach was used. The results showed that all nano-composites exhibited higher porosity content compared with the monolithic alloy. The porosity content of the nano-composites was found to be significantly influenced by both stirring speed and stirring temperature. Increasing stirring speed and/or the melt stirring temperature increases the porosity of the composites. Generally, the nano-composites fabricated using rheocasting technique exhibited lower hardness values when compared with the monolithic alloy due to their high porosity content. To reduce the porosity of the previously fabricated MMNCs, a squeezing process was performed. It has been found that such secondary process assisted in reducing significantly the porosity content of the MMNCs. The squeezed nano-composites exhibited higher hardness than the rheocast MMNCs.

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