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Effect of binder composition on rheological behavior of PMN-PZT ceramic feedstock

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Abstract

An investigation of the effect of binder composition on rheological behavior of lead magnesium niobate-lead zirconate titanate (PMN-PZT) ceramic feedstock is presented in this paper. Rheological behavior is the key factor for manufacturing a micro-sized structure with high aspect-ratio. Each binder composition was categorized into three groups to analyze the effect based on the variation of ratio within filler (first), within backbone (second), and between filler and backbone (third). The critical solids loading for each feedstock was evaluated using a torque rheometer. To compare the net effect of binder composition, all the feedstocks were mixed with the solids loading of 45 vol.%. The effects of binder composition on rheology were analyzed using a capillary rheometer with different shear rates and temperatures. The main rheological parameters, such as viscosity, shear sensitivity, and temperature sensitivity, were closely related to the molecular weight difference in binder composition. First, the viscosity increased as the ratio of binders with higher molecular weight increased for each group. Second, the sensitivity of viscosity on shear rate was enhanced with the increase of polyethylene (PE) in the second and backbone in the third, respectively. Third, the sensitivity of viscosity on temperature was lowered as the amount of binders with higher molecular weight increased for each group. Based on the experimental results, the moldability index as a function of viscosity, shear sensitivity, and temperature sensitivity was calculated. The feedstock with the largest amount of filler showed the best rheological property for powder injection molding.

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