Public Abstract

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Supercritical extraction is a viable alternate processing strategy for removing binder from green ceramic samples, as compared to the conventional thermal route used to remove binder. Using supercritical extraction, a large fraction of binder can be extracted in a fraction of time as compared to the regular thermal route. The mechanism of binder removal in supercritical extraction involves solvation of the extractable binder components into the supercritical phase, followed by diffusion of the solubilized species out of the pores of the green ceramic body.

Supercritical extraction using carbon dioxide was performed in a semi-continuous mode on the binder of an acrylate-based system, the results of which were compared with a poly (vinyl butyral)-based system. The solubility and weight loss from individual binder components were measured during supercritical extraction to inspect on the contribution of each of the components to the overall weight loss of binder in the acrylic-based multilayer ceramic capacitors. Optimization of the co-solvents was performed and the dynamics of supercritical extraction was quantified by calculating the diffusivity of the soluble species of binder.

A mechanism was suggested that addressed the issue of low yield of the acrylic-based multilayer ceramic capacitors, and a mathematical model was developed to describe the spatial and temporal development of pressure in the sample during depressurization. The model was based on flow of supercritical fluid in a porous medium. This model accounted for non-ideality of the supercritical fluid as well as for changes in viscosity with pressure. The model quantified the failure mechanism observed by simulating the depressurization conditions. Also, the effects of the body size and gas-phase permeability on the pressure within the green body were examined.