SUPERCRITICAL EXTRACTION OF BINDER FROM

MULTILAYER CERAMIC CAPACITORS

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ABSTRACT

Supercritical extraction using carbon dioxide was carried out in a semi-continuous mode on the binder and its components of an acrylate-based system, the results of which were compared with a poly (vinyl butyral)-based system. To investigate the contribution of each of the binder components to overall weight loss of the acrylic-based binder, pure components as well as combination of different components were subjected to supercritical extraction.

To enhance the extraction of binder, co-solvents were evaluated on the most extractable binder component and an optimal co-solvent loading was determined. Supercritical extraction experiments were then carried out and the effect of the co-solvent on the extraction profiles was examined. Enhancement in extraction was observed for the acrylic-based system whereas no overall enhancement was observed for the poly (vinyl butyral)-based system. To interpret the dynamics of supercritical extraction, diffusivities of the binder components of the acrylic-based and the poly (vinyl butyral based) multilayer ceramic capacitors were calculated, and were found to be in the same order of magnitude. Finally, visual analysis was performed on the acrylic-based system to suggest a mechanism that led to defects in these green ceramic bodies after the extraction process.

Supercritical extraction with carbon dioxide at 10-40 MPa and 55-90°C was used to remove binder from multilayer green ceramic bodies. Defects such as cracking and delamination

were occasionally observed in the green bodies following the extraction process, and these defects were attributed to pressure gradients that arise during depressurization from conditions of supercritical extraction. A model based on flow in porous media was thus developed to describe the temporal and spatial distribution of pressure within the green body during depressurization. The model incorporated the Peng-Robinson cubic equation of state to describe the pressure-volume-temperature behavior of the supercritical carbon dioxide, and the effect of changes in the viscosity of the supercritical fluid. The effects of the body size and gas-phase permeability on the pressure within the green body were examined.