Public Abstract
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Title:FAILURE ANALYSIS OF GREEN CERAMIC BODIES DURING THERMAL DEBINDING

During the processing of multilayer ceramic capacitors (MLCs), binders (polymers) are often added to increase the strength of the green body. These binders need to be removed prior to densification of the ceramic components. Binders are commonly removed by oxidation in air by subjecting the green body to heating cycles. The specification of thermal debinding cycle is a difficult problem and often leads to the failure of green body, due to inappropriate scheduling of the heating cycle. In order to develop optimum heating cycles, it is important to have an understanding of the failure behavior of green body during thermal debinding.

MLC green bodies, with barium titanate as the dielectric and poly(vinyl butyral) and butyl benzyl phthalate as the main components of the binder, have been subjected to rapid heating cycles in order to cause failure. Two methods were used in order to determine the failure conditions of the green bodies. In one approach, the heating rate was held constant and the dimensions of the green bodies were varied, while in the second method, the size of the green body was held constant and the heating rate was varied. In all cases, failure of the green body occurred between 115-140Â°C. Models showed that at the time of sample failure, binder loading was high and the pressure in the center of the green body was nearly constant, independent of the method used to cause the samples to fail. The internal pressure was then used with a previously developed algorithm to develop rapid debinding cycles without causing component failure.

Based on the results of previous work, relationships between spatial pressure distribution and spatial stress distribution are presented. Models for predicting the strength of the green body throughout the thermal debinding cycle were developed. The strength of the green body, the stress distribution and the internal pressure distribution were then related. Based on the combination of the results from the strength, pressure, and stress models qualitative assessments were made on how these important quantities are changing relative to each other during thermal debinding and how they influence the failure behavior. Furthermore, the tensile properties of the green ceramic tapes at different binder loadings and the binder system alone were studied.