Direct Observation of Internal Structure in Ceramic Green Bodies

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The immersion liquid technique was recently developed in our laboatory. The technique is a powerful tool in characterizing micro-defects in ceramic green bodies as well as in powder granules. The application of the technique is presented in this paper to examine internal structure of varieties of ceramic materials. Varieties of structures and defects were found in all materials examined.

The technique is based on the reduced internal reflection at the material interface of a similar refractive indices, and the procedure consists of the following steps.

1. Immersion of a liquid into the green body to make it transparent to visible light.
2. Observation with a transmission optical microscope through the whole body by changing the focus position.

In an alumina green body made by cold isostatic pressing of powder granules, a structure with many round shape was found at a low forming pressure. The structure is formed by the piling up of spherical granules which survived the compressive pressure of forming. With increasing forming pressure, the number of the round shape decreases. At the applied pressure 100 MPa, feature with the completely round shape becomes rare, rather the crack-like structure became dominant at three or four spheres junctions. The concentration of this type of defect decreased with increasing pressure, yet did not become zero even at the highest forming pressure examined in this study, 600 MPa.

The similar result was found in the isostatically pressed zirconia and silicon nitride green bodies. The removal of these defects are difficult but critical in producing high-performance ceramics.