Effect of Marangoni flow on Surfac Roughness and Packing Density of Inkjet-printed Alumina Film by Modulating Ink Solvent Composition

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Abstract : Two different micro-flows during the evaporation of ink droplets were achieved by engineering both surface tension gradient and compositional gradient across the ink droplet: (1) Coffee-ring generating flow resulting from the outward flow inside the ink droplet & (2) Marangoni flow leading to the circulation flow inside the ink droplet. The surface tension gradient and the compositional gradient in the ink droplets were tailored by mixing two different solvents with difference surface tension and boiling point. In order to create the coffee-ring generating flow (outward flow), a single-solvent system using N,N-dimethylformamide with nano-sized spherical alumina particles was formulated. Marangoni flow (circulation flow) was created in the ink droplets by combining N,N-dimethylformamide and formamide with the spherical alumina powders as a co-solvent ink system. We have investigated the effect of these two different flows on the formation of ceramic films by inkjet printing method. The packing density of the ceramic films printed with two different ink systems (single- and co-solvent systems) and their surface roughness were characterized. The dielectric properties of these inkjet-printed ceramic films such as dielectric constant and dissipation factor were also studied in order to evaluate the feasibility of their application to the electronic ceramic package substrate.

Key Words : Inkjet printing method, co-solvent, Marangoni flow, alumina thick film, surface roughness and packing density