DYNAMIC WETTING OF NITROCELLULOSE–BUTYL ACETATE–DIBUTYL PHTHALATE SOLUTIONS ON GLASS

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One of the challenges in the production of multilayer metal-ceramic packages based on high-temperature ceramics for integrated circuits is the formation of a vacuum-tight monolithic structure of the ceramic package containing metallized traces. Monolithicity and vacuum tightness are achieved by using a paste to bond several layers of the ceramic wafer and subsequent firing. The paste must have good adhesion properties to the unfired ceramic material. Therefore, in this study, we analyzed the surface wetting process with solutions used as lamination pastes for multilayer metal-ceramic integrated circuit packages. The pastes studied were three-component solutions consisting of nitrocellulose as a binder, butyl acetate as a solvent, and dibutyl phthalate as a plasticizer.

An equation was proposed that describes the dynamic contact line during the spreading of a solution droplet on the surface of a glass substrate as a function of time (Fig. 1):

$$r(t) = r_\infty - p_1 \cdot \exp(-\alpha_1 \cdot t^{1/2}) - p_2 \cdot \exp(-\alpha_2 \cdot t^{1/2}) \quad (1)$$

The proposed empirical equation is the sum of two exponential functions, each dependent on the square root of time, which may correspond to a diffusion process (Fig. 2). The relationship between droplet height and radius during spreading is shown, which for these solutions can be described by a logarithmic function. An experimental relationship between the dynamic contact angle and capillary number is presented.

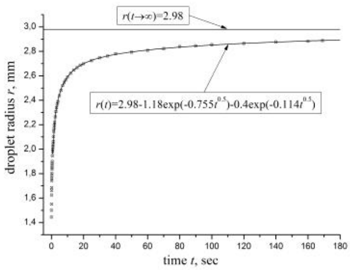

Figure 1. Time dependence of the droplet radius vs. time. Horizontal line corresponds to the equilibrium radius at t→∞. Solis line corresponds to Eq. (1).

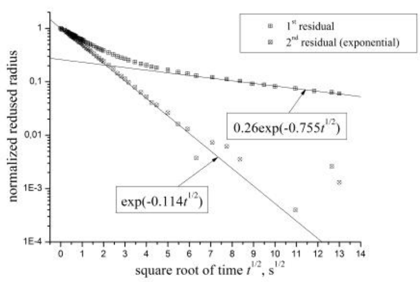

Figure 2. The procedure of decomposition of the original time dependence *r*(*t*) on two exponential components according to Eq. (1).