Technical Abstract No. 3:

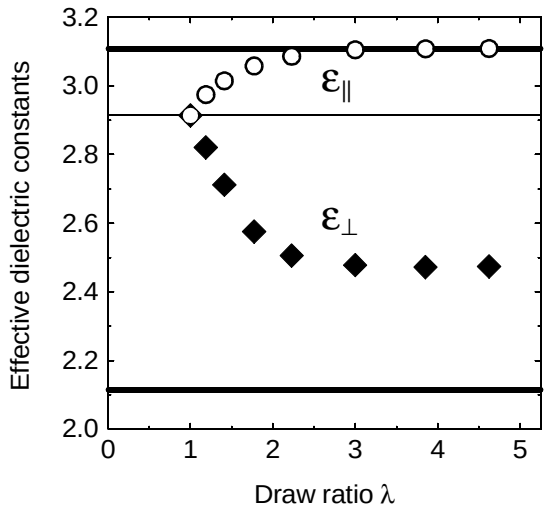
Designing Package Materials for Integrated Circuits that Allow Minimization of Microelectronic Components

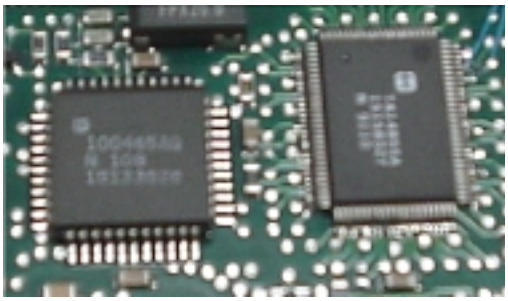
The dielectric constants for typical solid organic polymers are between 4 and 5. However, in microelectronics it is desirable to have packaging materials with a lower dielectric constant so that the size of components can be reduced. The design challenge is how to develop a package material that meets specifications without costly and time consuming bench scale experimentation.

Simulations with *Palmyra* show that macroscopically isotropic voided polymers, especially ones with spherical voids, are poorly suited for reducing the effective dielectric constants. In microelectronics, one usually uses polymer materials in the form of thin films with the electric field applied perpendicular to the film plane. As a result, one is interested in a low dielectric constant in the direction perpendicular to the film plane and is not concerned much about the dielectric constants in the lateral directions. The simulations indicate that flake-like voids oriented parallel to the surface can do the job.

Biaxial drawing is a traditional technological route employed for obtaining thin polymer films. Such biaxial drawing of a voided polymer can be employed to obtain films with flake-like holes. The figure indicates what can be expected in dielectric constant parallel and perpendicular to the film at a given biaxial draw ratio for a polymer with 30 % air, accurately predicted by *Palmyra*.

One can see that, at relatively small draw ratios, the effective dielectric constants are quite sensitive to the draw ratio. Therefore, in this domain of small draw ratios, one can sensibly control the effective dielectric constants by changing the draw ratio. The leveling off occurs at $\lambda \approx 3$ where the effective dielectric constants become practically independent of the further increase in the draw ratio. Any further drawing incurs cost, but will not significantly improve the properties.* **Here, *Palmyra* specifies the most desirable structure, both from the point of view of properties and cost.**





New package materials for integrated circuits allow further minimization of microelectronic components.

*) Ref: *A. A. Gusev*, Macromolecules **34**(9), 3081 (2001).