Deposition of sol-gel sensor spots by nanoimprint lithography and hemi-wicking

We present a method for homogeneous deposition of sol-gel sensor materials, which enable fabrication of sensor spots for optical pH and oxygen measurements inside plastic containers. A periodic pattern of posts is imprinted into a polycarbonate substrate and, using the principle of hemi-wicking, a deposited droplet spreads, guided by the posts, to automatically fill the imprinted structure, not being sensitive to alignment as long as it is deposited inside the patterned area. Hemi-wicking is an effective method to immobilize a low viscosity liquid material in well-defined spots on a surface, when conventional methods such as screen- or stamp-printing do not work. On length scales of the order of the microstructure period, surface tension will govern the shape of the liquid-air interface, and the liquid will climb up the pillars to keep a fixed contact angle with the sidewalls. The surface to volume ratio is therefore constant all over the surface of the liquid spread by hemi-wicking, when considering length scales larger than the microstructure period. Material redistribution caused by solvent evaporation, i.e., the "coffee ring effect", can therefore be avoided because the evaporation rate does not vary on length scales larger than the periodic pattern.

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Contributors: Mikkelsen, M. B. L., Marie, R., Hansen, J. H., Nielsen, H. O., Kristensen, A.
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