Micropatterning of a stretchable conductive polymer using inkjet printing and agarose stamping

A highly conducting stretchable polymer material has been patterned using additive inkjet printing and by subtractive agarose stamping of a deactivation agent (hypochlorite). The material consisted of elastomeric polyurethane combined in an interpenetrating network with a conductive polymer, poly(3,4-ethylenedioxythiophene) (PEDOT). The agarose stamping produced 50 μm wide conducting lines with high spatial fidelity. The deactivation agent was found to cause some degradation of the remaining conducting lines, as revealed by a stronger increase in resistance upon straining compared to the pristine polymer material. Inkjet printing of the material was only possible if a short-chain polyurethane was used as elastomer to overcome strain hardening at the neck of the droplets produced for printing. Reproducible line widths down to 200 μm could be achieved by inkjet printing. Both methods were used to fabricate test patterns that allowed the electrical resistance parallel and perpendicular to the elongation direction to be measured. Electrical resistance increased both parallel and perpendicular to the direction of strain, with a faster increase observed parallel to the straining.