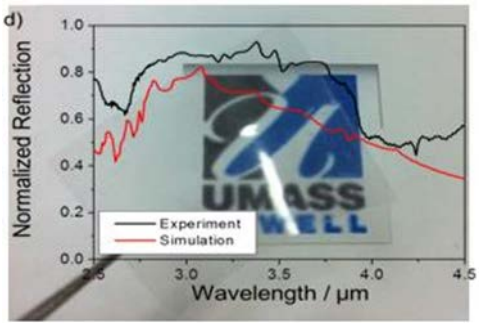
Conductive Polymer Assembly

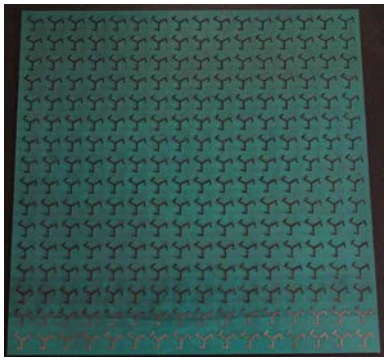
Conducting polymers offer advantages for the fabrication of novel nanoscale devices over metal and traditional semiconductors, such as convenient processing and adjustable conductivity. High-rate methods for fabricating nanoscale patterned conducting polymers are therefore of significant technological importance.

In our research, electrophoretic and dielectrophoretic assembly were used to assemble polyaniline (PANi) into nanoscale patterns in less than one minute. Both of these techniques provide a high rate and cost-effective approaches for nanomanufacturing because electric fields permit complete assembly in 1 minute or less as well as easy of control of dimensions using assembly time and amplitude or frequency of the electric field.

Figure 1.



a.) Theoretical vs. measured performance of an assembled IR wavelength metamaterial. Actual assembly on film held over graphic..



b.) PANi assembled on template

c.) PANi assembled on a flexible polyurethane film

As expected by electrophoretic and dielectrophoretic deposition increased with voltage, time, and the concentration of the polyaniline suspension. Dielectrophoretic assembly, however, was best at lower frequencies (in contrast to the higher frequencies as predicted by the Clausius-Mossotti factor) and also reduced damage to the gold electrodes (wires) on the templates, thus is preferred for nanomanufacturing. The dimensions of the electrode patterns on templates also influenced deposition, with deposition increasing linearly with the ratio of the pitch to line width of the electrodes. Using this method, large area of nanoscale patterns with dimensions of the assembled PANi down to 100 nm were fabricated, much smaller than previously reported. The assembled PANi can be further transferred to other flexible substrates, providing a fast, easily-controlled and promising approach for assembly of conducting polymers for fabrication of nanoscale devices.

Center for High-rate Nanomanufacturing

Publication List:

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