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Abstract for an Invited Paper
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Reaction-Diffusion Patterns in Structured Media

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I will look at pattern formation in the Belousov-Zhabotinsky (BZ) oscillating chemical reaction in media that are structured at length scales ranging from ten nanometers to a few centimeters. A reverse microemulsion consisting of nanometer diameter droplets of water containing the reactants dispersed in oil allows the physical structure (size, spacing) of the droplets and their chemical composition to be controlled independently, enabling one to generate a remarkable variety of stationary and moving patterns, including Turing structures, ordinary and antispirals, packet waves and spatiotemporal chaos. One- and two-dimensional arrays of aqueous droplets in oil generated by microfluidic techniques have diameters of the order of 100 micrometers and produce a different array of patterns that can be precisely controlled with light. In particular, circular arrays of droplets provide a testing ground for some of Turing's ideas about morphogenesis. By attaching the BZ catalyst to a polymer that shrinks and swells in response to changes in the redox state of the catalyst, one can construct gel materials that transduce chemical changes to mechanical motion, a phenomenon modeled with considerable success by the Balazs group. If time permits, I will also discuss the BZ reaction in coupled macroscopic flow reactors that mimic small neural networks.