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Control of Molecular Transport and Chemical Reaction Dynamics in Confined Volumes PAT COLLIER, Oak Ridge National Laboratory — Understanding how confinement, crowding and reduced dimensionality modulate biochemical reactivity and reaction dynamics will aid in the discovery of functionality unique to nanoscale systems. Biochemical reaction kinetics in biomimetic reaction vessels with confined volumes present in microfabricated structures have been determined, including monitoring single-enzyme reaction kinetics in femtoliter-volume (10^{-15} L) chambers with millisecond mixing times, and the discovery and characterization of shear-induced redistribution of surfactant at the oil-water interface in femtoliter-volume droplets split off from larger aqueous plugs at a microfabricated T-junction, which resulted in increased interfacial adsorption of enzymes. The fabrication capabilities at the Center for Nanophase Materials Sciences at ORNL are extending these studies to nanoscale structures, interfaces and architectures, with the ability to control chemical reaction kinetics with precise spatiotemporal control of molecular/mass transport via integration with microfluidics.

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