Super-Photoreagents as a Gateway to Precision Chemistry

Technologies such as nanolithography, precision delivery and activation of pharmaceutical compounds, high-speed chemical sensing, and localized catalysis ultimately hinge on the ability to control chemical reactions in space and time. Precision chemistry, performed *in situ* and on-demand, calls for reagents that can be turned on or off with control over location and duration. Chemical reactions fall into two broad categories; acid/base and electron transfer. Our initial focus is on photo-activated acid/base chemistry. The light-activated potent chemical reactivity of super-photoacids ($pK_a^* < -6$) and super-photobases ($pK_a^* > 20$) offers the potential for such temporal and spatial reaction control. The discovery of super photoreagent compounds, however, is extremely challenging. In fact, only one super-photobase is known. Our multidisciplinary approach consisting of synthesis, characterization, and theory, will target a set of desired characteristics and work synergistically in a closed loop approach to arrive at the desired compound(s). *This proposal is responsive to the need for novel functional and structural materials and manufacturing processes.* To illustrate this point, we envision two sample applications that would benefit from such an effort: precision nano-photolithography, such as that used in the manufacture of microchips, and the development of a nano pH meter capable of finding and characterizing catalytic active sites on heterogenous catalysts having extreme reactivity. These super-photoreagents will make such applications possible thanks to the world-class capabilities of the proposing team in synthesis, high-level quantum chemistry theory, and advanced optical characterization.