Progress in gas-phase and gas-surface reaction modeling for hypersonic flows

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Within the high-temperature shock layer that surrounds a high-speed vehicle, molecules undergo rapid rotational and vibrational excitation; ultimately dissociating into reactive atomic species that destroy the vehicle's heat shield. Modeling such high-speed flows is challenging because of strong thermochemical nonequilibrium involving molecular internal energy distributions that are non-Boltzmann. During the past decade, computational chemistry has been used to investigate these processes from first-principles. The first half of the talk will summarize this effort and the progress that has been made.

As understanding of gas-phase processes improves, focus shifts to understanding gas-surface chemistry under high temperature conditions. Over the past decade, a significant number of molecular beam surface scattering experimental campaigns have been completed. The second half of the talk will summarize how these new experiments, which study *individual* gas-surface reaction mechanisms, have helped advance gas-surface reaction models for hypersonic flows.