TIME RESOLVED INFRARED EMISSION FROM VIBRATIONAL EXCITED ACETYLENE FOLLOWING SUPER ENERGY TRANSFER COLLISIONS WITH HOT HYDROGEN

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Can a molecule be activated with large amounts of energy transferred in a single collision between an atom and a molecule? If so, this type of collision will greatly affect molecular reactivity and equilibrium in systems including combustion where abundant hot atoms exist. Conventional expectation of translation to vibration (T-V) energy transfer is that probability decreases exponentially with energy transferred. We show, however, that in collisions between a pair of atom/molecule for which chemical reactions may occur, such as between a hyperthermal H atom and an ambient acetylene molecule, (T-V) energy transfer occurs with surprisingly high efficiency through chemical complex formation. Time-resolved infrared emission observations reveal that collisions between H atoms moving with 60 kcal/mole energy and acetylene molecules result in transfer of up to 70% of this energy into vibrational degrees of freedom. These experimental results are further supported by state of the art quasi-classical trajectory calculations performed by Bowman and coworkers.