MECHANISM OF THE MULTIPHOTON DISSOCIATION OF SO_2 VIA THE $\tilde{H}$ RYDBERG STATE

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We will present a study on the mechanism of multiphoton dissociation of the SO_2 molecule through the $\tilde{H}$ Rydberg state. For this study, a homemade Wiley-McLaren linear time-of-flight (TOF) spectrometer was constructed to characterize the fragments produced during irradiation of SO_2 with a laser beam in the 222 - 234 nm region. Both SO^+ and S^+ fragment ions were detected but no parent SO_2^+ appeared. The mass resolved excitation spectra (MRES) of both SO^+ and S^+ display the SO_2 $\tilde{C}\ ^1B_2 \leftarrow X\ ^1A_1$ vibrational progressions. The first photon in the studied region pumps SO_2 to the $\tilde{C}\ ^1B_2$ electronic state. The second photon further excites the molecule to the $\tilde{H}$ Rydberg state, where it dissociates into SO + O and S + O_2 fragments. The third photon then ionizes the SO fragment. From the power dependence of the ion intensity and a kinetic model we developed, we conclude that S^+ is produced by a one-photon dissociation, $SO^+ + h\nu \rightarrow S^+ + O$. The internal energy distributions of the fragmentation products from dissociation of SO_2 via the $\tilde{H}$ Rydberg state were also obtained using an ion-imaging spectrometer. The following five dissociation channels are observed: SO($B\ ^3\Sigma^-$) + O($^3P_2$), SO($A^3\Pi$) + O($^3P_2$) , S(^1D) + O_2($b^1\Sigma_g$), S(^1D) + O_2($a^1\Delta_g$), and S(^1D) + O_2($X^3\Sigma^-$).