Photoionization Spectra of Atomic Sulfur from Photodissociation of Cyclic Sulfides at 193 nm Detected with Photoionization Mass Spectroscopy

Wan-Chun Pan (潘婉君)[1,2], Yin-Yu Lee (李英裕)[2], Tzu-Ping Huang (黃自平)[2], and I-Chia Chen (陳益佳)[1]

[1]Department of Chemistry, National Tsing Hua University, Hsinchu, Taiwan
[2]National Synchrotron Radiation Research Center, Hsinchu, Taiwan

The photodissociaiton studies of ethylene sulfide and trimethylene sulfide (TMS) at 193 nm are investigated using the method of photoionization mass spectroscopy (PIMS). The product sulfur atoms from photolysis channels of both $C_2H_4S \rightarrow C_2H_4 + S$ and $C_3H_6S \rightarrow C_3H_6 + S$ are ionized by VUV synchrotron radiation generating from the undulator at NSRRC U9CGM beamline and are detected by the quadruple mass spectrometer. The autoionizing series of sulfur atoms appearing on the acquired ionization spectra are due to the single photon excitation of VUV light. The resolving power (E/ΔE) of this work depends on the resolving power (E/ΔE) of the spectrograph located at the beamline and the value is about 60000 at 10 eV. Because of the high spectral resolution of the light source, the most lines are resolved.

The photoionization spectra of atomic sulfur are assigned and the observed autoionization serieses: $(^2D_o)nd^3S^o$, $^3P^o$, $^3D^o$ and ns^3D^o are shown to be quaidiscrete. According to the assigned transitions and their intensities we can determine the branching ratio of product surfur atoms formed in electronic states S ($^3P_{2,1,0}$) and S ($^1D_2$) from both TMS and ethylene sulfide. As the results in this work we find that the branching ratio of sulfur atom from 193 nm photolysis of ethylene sulfide is 1.2 which is almost the same with previous works. The photoionization spectra in his work show the evidences of the product S ($^1D_2$) from 193nm photolysis of TMS that was never observed and evidenced by others.

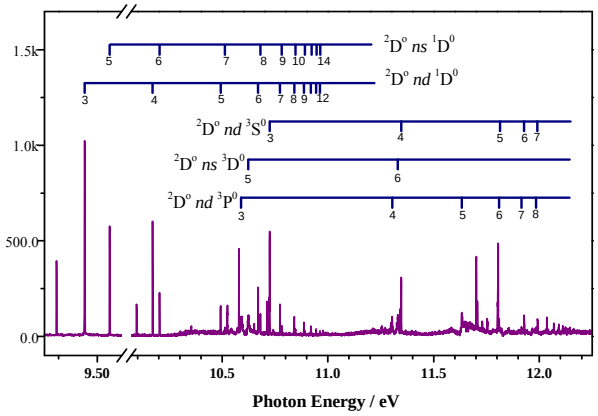

Figure 1. Photoionizaiton Mass spectra of atomic sulfur from photolysis ofethylene sulfide (ES, C_2H_4S) at 193 nm. The spectra show that aotoionization series of S (^3P)–S^+ ($^2D_0$) and S (^1D) – S^+ ($^2D_0$) transitions both are existed.

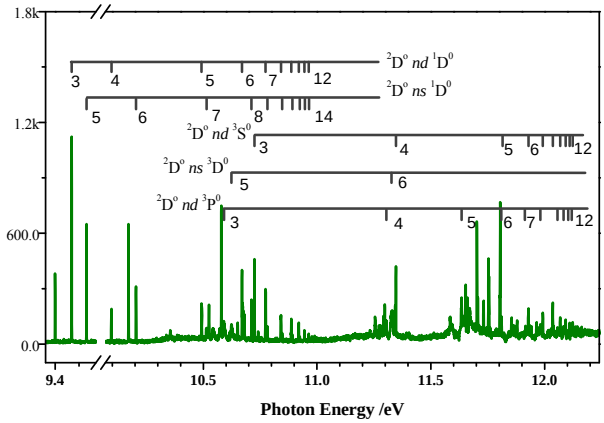

Figure 2. Photoionizaiton Mass spectra of atomic sulfur from photolysis of trimethylene sulfide (TMS, C_3H_6S) at 193 nm. The spectra show that aotoionization series of S (^3P)–S^+ ($^2D_0$) and S (^1D) – S^+ ($^2D_0$) transitions both are existed.