

ELECTRONIC EXCITATION OF TETRAFLUOROETHYLENE, C₂F₄

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C₂F₄ is formed within current plasma processing cells by electron or photon impact dissociation and thermal decomposition of c-C₄F₈, a feed gas used for oxide etching [1]. The molecule has also attracted interest as an environmentally-friendly alternative feed gas for the plasma etching of silicon dioxide, a process traditionally performed using CF₄, C₂F₆, C₃F₈, CHF₃, and c-C₄F₈. These species have very high global warming potentials (GWP) as they absorb strongly in the infrared and have very long residence times in the Earth's atmosphere. Under the terms of the Kyoto protocol such gases should be phased out by 2008 in favour of species with lower GWP. Due to the weak C=C bond, C₂F₄ is readily dissociated into two fragments of CF₂ [2]. The stratospheric photolysis lifetime of C₂F₄ is estimated using the present photo-absorption data to be of the order of 100 days. Previously, the atmospheric lifetime of the molecule by reaction with OH, NO₃ and O₃ has been estimated as 2 days [3]. The molecule is thus considered to have minimal global warming effect. It has been proposed that by using a combination of C₂F₄ and CF₃I, another species expected to have low GWP, etching and polymerization on the sample surface can be independently controlled through the selective generation of CF₂ and CF₃ radicals [4]. Electron scattering and photo-absorption studies of CF₃I have recently been reported [5, 6].

A high resolution UV photo-absorption spectrum of C₂F₄ was recorded over energies relevant to the excitation of electrons in the outer-most valence orbitals. Electron energy loss spectra (EELS) using incident electrons of 100eV and photo-electron spectra were also recorded. The data from the three experiments have allowed us to perform a detailed analysis of the observed valence, Rydberg, and vibrational structure. The spectroscopic work presented here provides important quantitative data which can be used to model the behaviour of C₂F₄ both in the atmosphere and in future reactors.

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