Optical oscillator strengths of the valence-shell excitations of acetylene studied by high-resolution X-ray scattering

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Synopsis The optical oscillator strengths (OOSs) of the valence-shell excitations of acetylene play an important in the understanding of many different aspects of atmospheric physics. Based on the high-resolution X-ray scattering technique, the OOSs of acetylene are obtained by extrapolating the generalized oscillator strengths (GOSs) to the limit of the momentum transfer $q \to 0$.

As an important astrophysical molecule, acetylene is abundant in the interstellar medium, carbon stars and planetary atmosphere, so acetylene is a key diagnostic in the astronomical observations, and its OOSs are the basic and important parameters to explain the complex astronomical spectra.

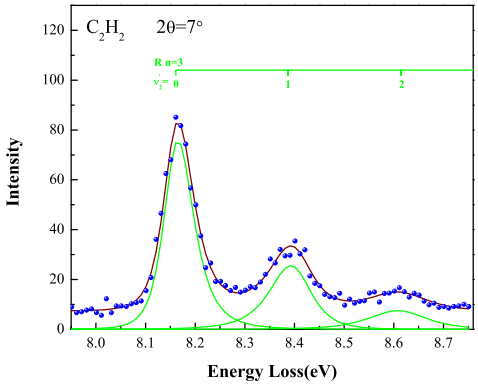

Figure 1. A typical energy loss spectrum of the valence-shell excitations of acetylene at 7°. Solid lines are the fitted curves.

With such importance and application value, the OOSs of the valence-shell excitations of molecular acetylene were determined by high-resolution X-ray scattering in this work through extrapolating the GOSs to the limit of the momentum transfer $q \to 0$. In the measurement, the analyzer energy for the scattered photon was fixed at 9889.90 eV and the energy resolution was 70 meV. The energy loss spectrum of molecular acetylene at 7° is shown in Fig.1 along with the vibrational states assigned.

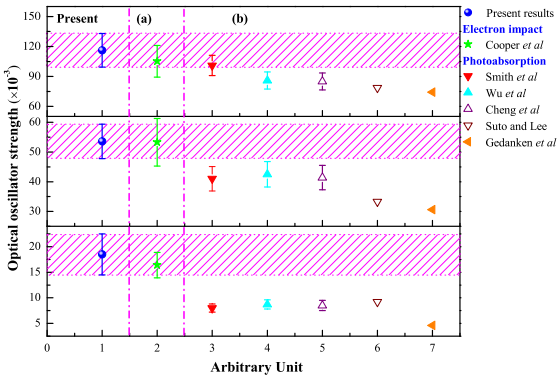

Figure 2. The present and previous OOSs of R30, R31 and R32 of acetylene from top to bottom.

The present and previous OOSs are shown in Fig.2. It is obvious from Fig.2 that the present results are agreement with the results of Cooper *et al*. [1] measured by the dipole(e,e) method, while both of these results are higher than the ones of Smith *et al*. [2], Wu *et al*. [3], Cheng *et al*. [4], Suto and Lee [5] and Gedanken *et al*. [6] measured by the photoabsorption method, which may be due to the line saturation effect. In summary, the present results provide an independent crosscheck for the measured OOSs of molecular acetylene.

References

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