ELECTRON INDUCED FLUORESCENCE OF CARBON MONOXIDE

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Introduction

Carbon monoxide [CO] is a relatively abundant molecule in the Universe and it is an essential life-forming molecule. It is one of the dominant carbon bearing molecules in extra-terrestrial bodies such as comets or centaurs. Especially the $A^2\Pi - X^2\Sigma^+$ transition of CO^+ is prominent in emission spectra of the comet tails and is referred to as the Comet Tail system. The diagnostic of these cometary volatiles is a necessity for solar system formation models [1]. CO molecule is also present in interstellar gas clouds which are the precursors of star formation. It is commonly used as a tracer of H_2 in the interstellar medium, which is difficult to observe on its own as it lacks a permanent dipole moment [2]. It is also an important compound of planetary atmospheres, such as Mars or Venus. Tracking atmospheric CO on Mars is an effective method for exploring the oxidizing capacity of the Martian atmosphere [3].

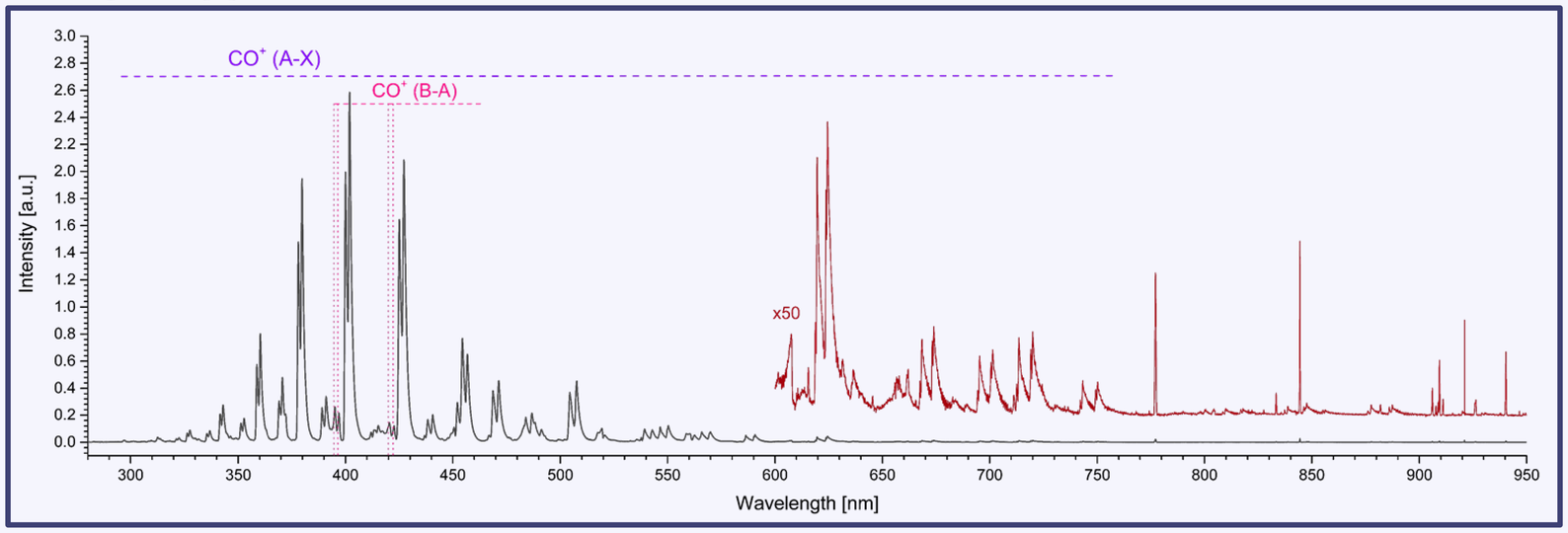


Fig. 2: *The emission spectrum of CO measured by CCD camera at 50 eV.*

Experimental results

The spectral electron energy graph of CO within the wavelengths of 275 – 1030 nm was measured at several electron energies ranging from 5 eV to 100 eV with steps closely together in the threshold region and with lower density above 50 eV. It is depicted in Fig. 3. The spectra form a surface corresponding to excitation-emission functions for transitions within the selected spectral range which can be calibrated to absolute scale to determine emission cross-sections in the measured spectral and energy range.

The excitation-emission function measured at 403.1 nm is depicted in Fig. 4. It is a mixture of signal from two different transitions, which are characterized by two threshold energies. Threshold energy of a transition is the minimum possible energy for a given process to occur. The first threshold at 9.5 eV is of the emission of CO ($a'^3\Sigma^+ - a^3\Pi$). The second one at 17.5 eV corresponds to the emission of CO^+ ($A^2\Pi - X^2\Sigma^+$).

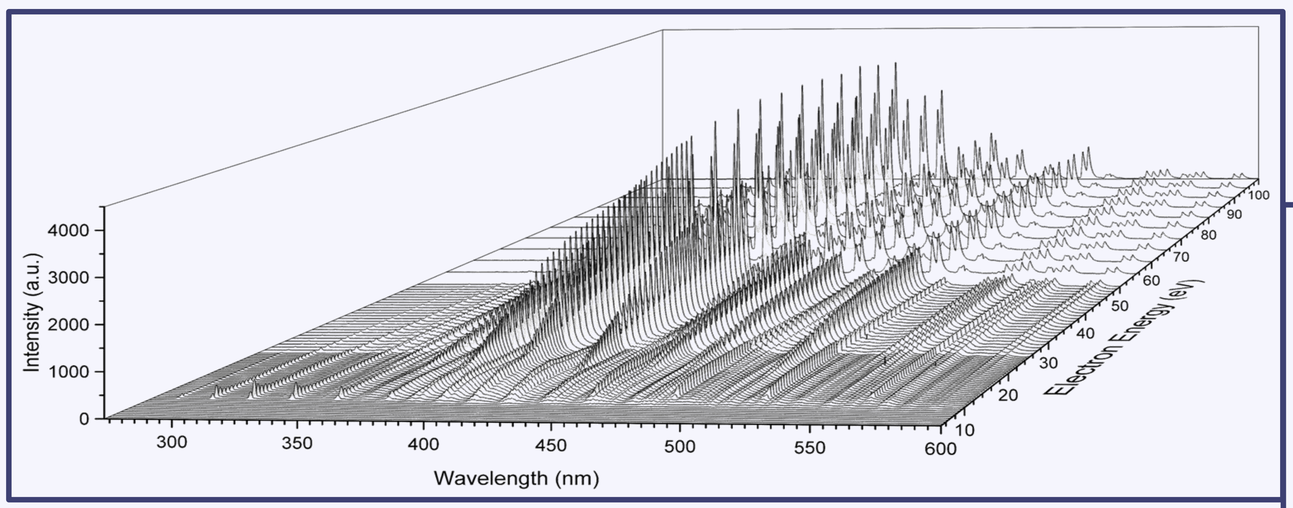


Fig. 3: *The spectral electron energy graph of CO within the wavelengths 275-600 nm (left) and 600-1030 nm (right).*

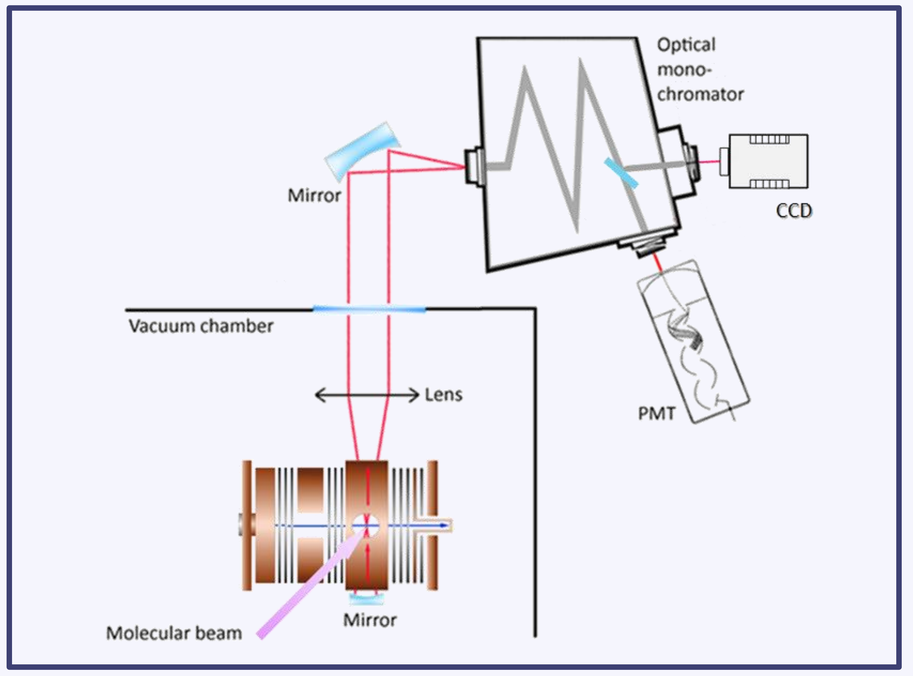


Fig.1: *Scheme of electron induced fluorescence apparatus.*

Experimental setup

The experimental setup is located at Comenius University in Bratislava, Slovakia, and consists of a crossed-beam configuration combining an electron monochromator and a gas beam. The electron induced emission spectra are measured using a Czerny–Turner optical monochromator, which provides a spectral resolution of 0.3nm FWHM and is equipped with a photomultiplier that is sensitive between 185 and 900 nm, and a CCD camera operating at wavelengths from 300 to 1100 nm.

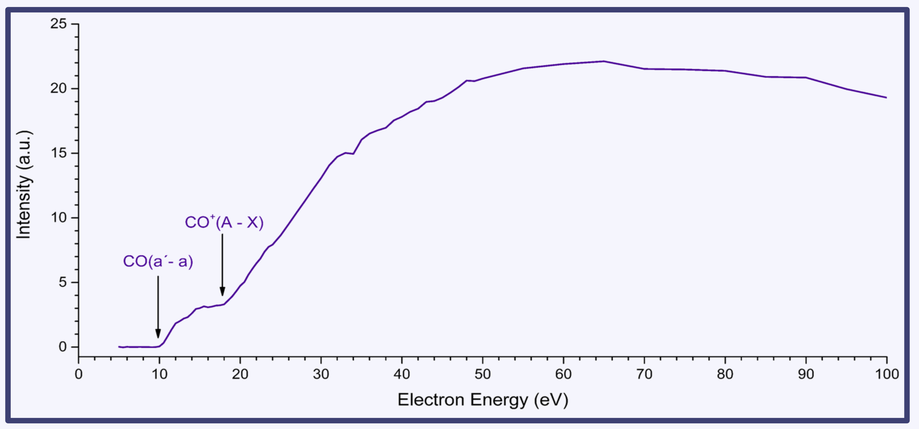
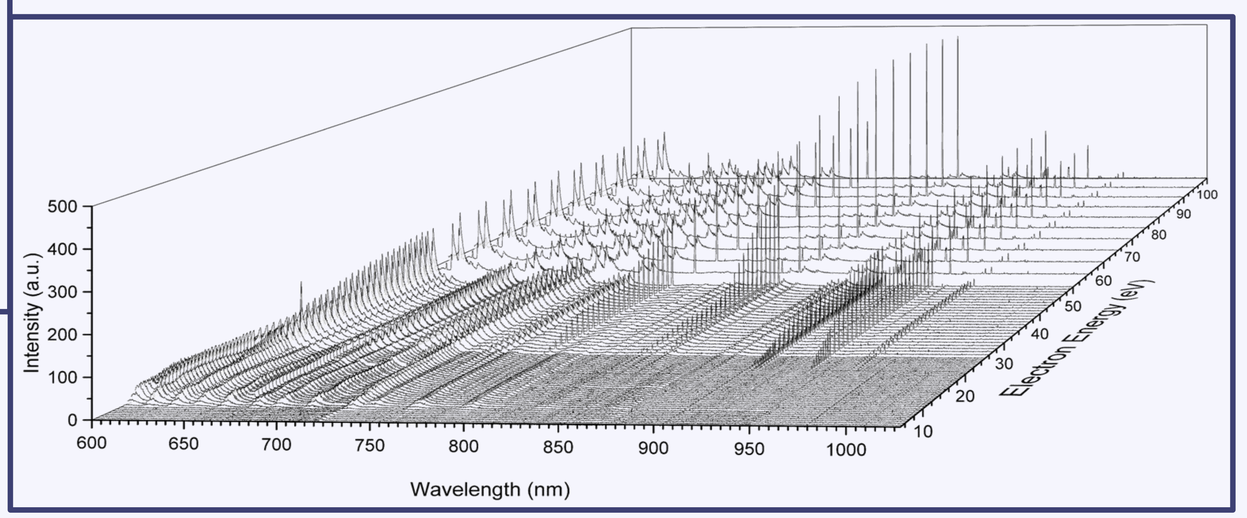


Fig. 4: *Excitation-emission function of a mixture of CO and CO^+ emission at 403.1 nm.*



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Acknowledgments. The presented research was within the projects nr. 1/0489/21, 1/0553/22, by Slovak Research and Development Agency within projects nr.APVV-19-0386, APVV-15-0580, by CU Grant 2023 nr. UK/321/2023 and by NASA ROSES project nr. NNH18ZDA001N-RDAP. This research has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871149.