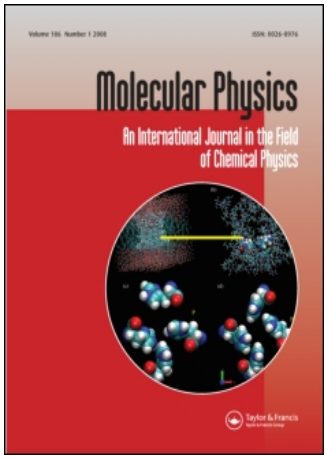


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# Photoabsorption cross sections of CO from λλ520-730 Å

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# Photoabsorption cross sections of CO from λλ520–730 Å

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Using synchroton radiation as a continuous background the photoabsorption cross sections of CO have been measured from λλ180–650 Å and reported in a previous paper [1]. However, due to the relatively low intensity of the synchrotron radiation, the structure near λ550 Å reported by Sasanuma *et al.* [2] and Codling and Potts [3] was not observed. Recently, the University of Wisconsin storage ring facility has been improved and the synchrotron radiation has been increased about an order of magnitude. The CO photoabsorption cross sections in the λλ520–730 Å region have been remeasured and structure is now observed.

The experimental set-up and the technique used to analyse the data have been described in previous papers [1, 4]. The photoabsorption cross sections were measured with a double ionization chamber. The CO gas was separated from the high vacuum storage ring by a tin film, which transmits light from λλ520–800 Å. In this region stray light is negligible [4]. The resolution of the vacuum monochromator used to disperse the source radiation was set at approximately 1 Å. In the region λλ520–640 Å the uncertainty in the absorption cross sections for the broad features ($\lesssim 1$ Å) is estimated to be within 10 per cent of the given values. However due to the resolution limitation of the monochromator, the cross sections given for the sharp discrete states (linewidth $\lesssim 1$ Å) represent only lower limits of the true cross sections.

The measured photoabsorption cross sections of CO are shown in the figure. The data given by Cairns and Samson [5], Starr and Loewenstein [6], Bennett *et al.* [7] and Cook *et al.* [8] are shown for comparison. The positions of the Rydberg states ($R_B$-sharp, diffuse, III–V) converging to the $v'=0$, 1 and 2 of the $CO^+(B^2\Sigma^+)$ states given by Ogawa and Ogawa [9], and the various vibrational progressions of the Rydberg states, $ns\sigma$, $nd\sigma$, and $nd\pi$, given by Codling and Potts [3] are also indicated in the figure. Recently, Asbrink *et al.* [10] have measured the HeII (304 Å) photoelectron spectrum of CO and accordingly reassigned the Rydberg states observed by Codling and Potts [3].

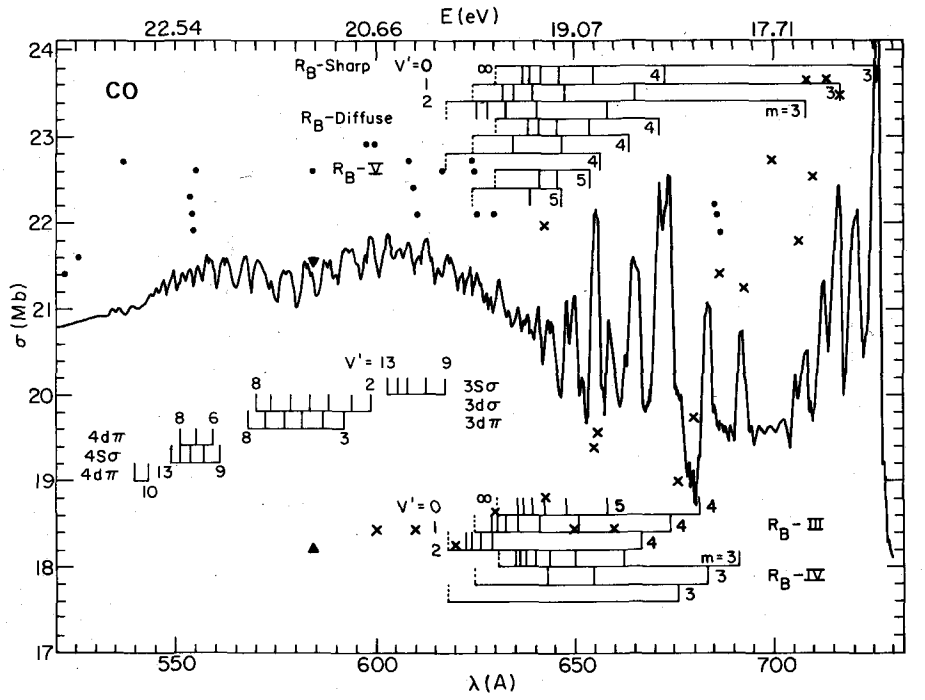
Codling and Potts [3] and Asbrink *et al.* [10] have suggested that the observed Rydberg states may involve two-electron excitations. For example, some of the observed Rydberg states result from the following transitions [3] :

$$(\pi 2p)^{-1}\,(\sigma 2p)^{-1}\,(\pi^* 2p)\; ns\sigma,\; nd\sigma,\; nd\pi \leftarrow X^1\Sigma^+,$$

or

$$(\pi 2p)^{-2}\,(\pi^* 2p)\; ns\sigma,\; nd\sigma,\; nd\pi \leftarrow X^1\Sigma^+$$

where $n=3, 4, 5, \ldots$.




The absorption cross sections of CO in the region from λλ520–730 Å. (The data of others are included and are identified as follows : ● = Cairns and Samson ; ▼ = Starr and Loewenstein ; ▲ = Bennett *et al.*; and × = Cook *et al.*) The Rydberg states, $R_B$-sharp, diffuse, and III–V given by Ogawa and Ogawa, and $ns\sigma$, $nd\sigma$, and $nd\pi$ given by Codling and Potts, are indicated in the figure.

These states result from excitation of a bonding $\pi 2p$ electron to an antibonding $\pi^* 2p$ orbital, with simultaneous excitation of a non-bonding $\sigma 2p$ or a bonding $\pi 2p$ electron to a Rydberg orbital. The molecules excited to such states are expected to be highly dissociative since there are fewer bonding electrons and more antibonding electrons. In fact, the cross sections for the production of fluorescence from the photodissociation fragments of CO show structure in the region from λλ570–610 Å [11]. At the positions of the $3d\sigma$ and $3d\pi$ Rydberg states the magnitude of the structure observed in the fluorescence cross sections is comparable to that found for the total absorption structure obtained here at approximately the same resolution. On the other hand, the production cross section for the $CO^+(B^2\Sigma^+ \rightarrow X^2\Sigma^+)$ and $CO^+(A^2\Pi \rightarrow X^2\Sigma^+)$ fluorescence shows no structure in this region [12, 13]. From these observations it is concluded that the neutral molecules excited to Rydberg states are primarily dissociated.

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