

EMISSION SPECTRA OF TOLUENE AND ANISOLE  
BY CONTROLLED ELECTRON IMPACT

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The emission spectra of toluene and of anisole were observed by exciting them by controlled electron impact up to 300 V. A characteristic band of the aromatic hydrocarbon was observed in both cases.

Though controlled electron impact is able to excite gaseous molecules and to induce photoemission of excited molecular species at very low pressure where the effect of collisions is greatly reduced, experimental difficulties have limited applications of the method to di- and tri- atomic molecules until very recently.<sup>1)</sup> The emission spectrum of benzene by this method was reported and well-resolved bands were assigned to the  $^1B_{2u} - ^1A_{1g}$  transition.<sup>2)</sup> An instrument for the measurement of the emission spectra by controlled electron impact under high vacuum has been constructed<sup>3)</sup> and the spectra of toluene and of anisole are reported here.

A typical emission spectrum of toluene is obtained by exciting it by 300 V electron impact, as shown in Fig. 1. The fluorescence spectrum of gaseous toluene has many prominent structures in the 267 - 320 nm region,<sup>4)</sup> which have been assigned to the transition between the lowest excited singlet state ( $S_1$ ) and the ground electronic state ( $S_0$ ). The present emission band at 267 - 320 nm by electron impact is identical in location and similar in vibrational structures

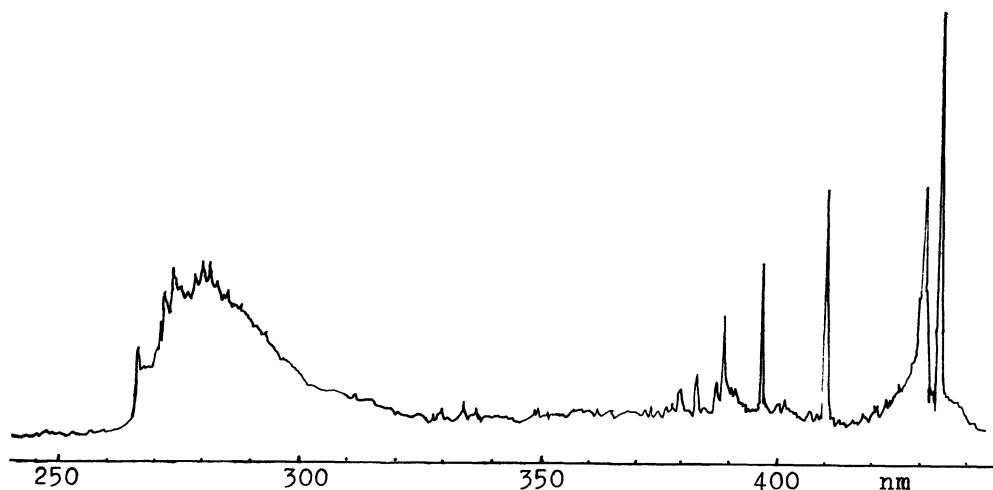


Fig. 1 Emission spectrum of toluene by electron impact  
Impact voltage 300 V

to the fluorescence spectrum, and thus this band is assigned to the  $S_1 - S_0$  transition of toluene.

The spectrum of anisole lies in a slightly longer wavelength region than that of toluene. The fluorescence spectrum in a cyclohexane solution has a band in the 275 - 320 nm region.<sup>5)</sup> A typical emission spectrum of anisole is shown in Fig. 2, where the impact voltage was 300 V. The observed band in the 274 - 320 nm region is assigned to the transition from the lowest excited singlet state to the ground state by reference to the fluorescence spectrum as in the case of toluene. Both of them are found to show a characteristic band of the aromatic hydrocarbon by electron impact.

Besides the aromatic band, there are some additional features in the emission spectra of toluene and of anisole as shown in the Figure. These features were assigned to the photoemission of some smaller fragments by comparing them with known spectra.<sup>6)</sup> The lines at 434, 410, 397 and 389 nm are assigned to the hydrogen Balmer series. The bands at around 431 and 389 nm are assigned to CH radicals. In addition the spectrum of anisole has some features of the Comet-tail system of  $CO^+$ , the first negative system of  $CO^+$  and the third positive bands of CO.

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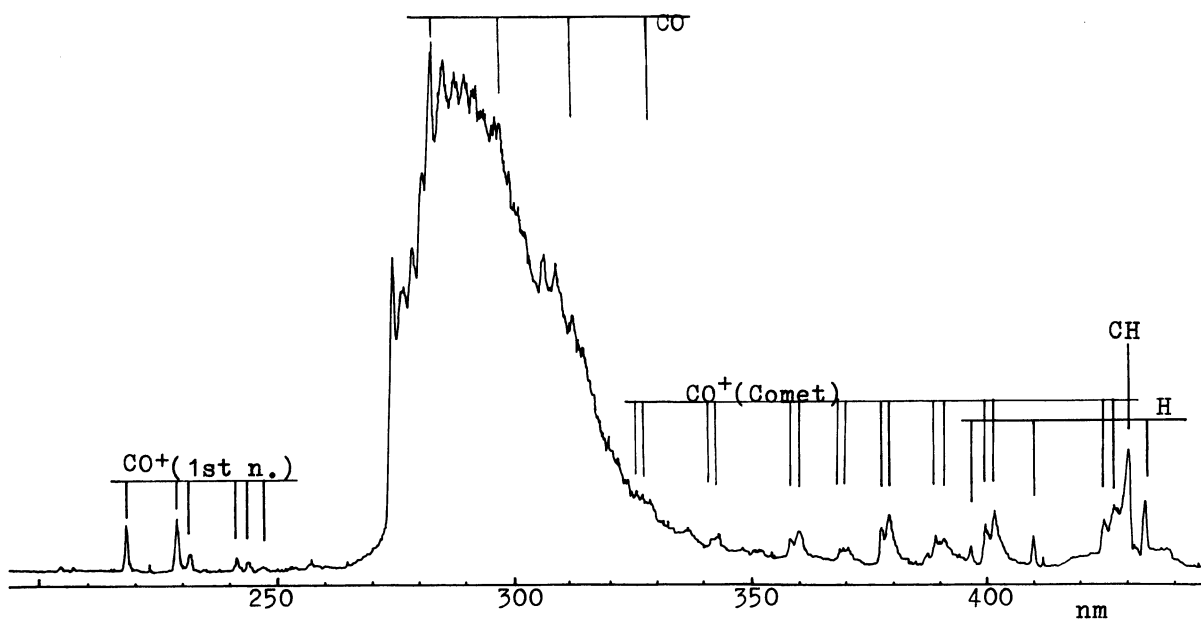


Fig. 2 Emission spectrum of anisole by 300 V electron impact

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