

Experimental differential cross sections for electron impact excitation of the electronic bands of furfural

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Synopsis. We report results from an experimental investigation into electron scattering from the important industrial species furfural ($C_5H_4O_2$). Differential Cross Sections (DCSs) have been measured for the electron impact excitation of the electronic states of furfural. The measurements were carried out at energies in the range 20–40 eV, and for scattered-electron angles between 10° and 90° . To determine absolute differential cross sections for electron impact excitation of the bands of inelastic electronic-states in furfural [8,9], we begin with measurements of electron energy loss spectra (EELS).

Furfural is solely produced through the thermochemical pre-treatment of biomass and so while it is desirable, from a commodity viewpoint, to increase the conversion efficiency of hemicellulose into furfural its production within some bio-refineries is actually undesirable. This follows as it can inhibit enzymes responsible for up-conversion of pre-treated biomass [1,2]. Hybrid strategies represent a possible path forward to realising novel methods in biomass conversion [3], with atmospheric pressure plasmas [4,5] or electron-beam irradiation (EBI) [6,7] having been identified as alternative approaches for pre-treating biomass. To determine absolute differential cross sections for electron impact excitation of the bands of inelastic electronic-states in furfural [8,9], we begin with measurements of electron energy loss spectra (EELS).

by the solid red line, while the fits to the various Bands I–VI are also shown as dashed blue lines.

The angular range of the present EELS was $10^\circ - 90^\circ$. EELSs were collected at each θ and incident electron energy ($E_0 = 20, 30$, or 40 eV) by recording the number of scattered electrons detected at each energy loss (E_L) value. The overall instrumental energy resolution in these measurements was ~ 80 meV (FWHM), which was insufficient to resolve many of the electronic-states from one another [8]. Consequently, bands of excited electronic-states are reported here (see Fig. 1).

It was investigated how the physicochemical properties manifested themselves on the behaviour of the electronic-state DCSs of furfural, with particular interest in analysing their influence on the angular distributions.

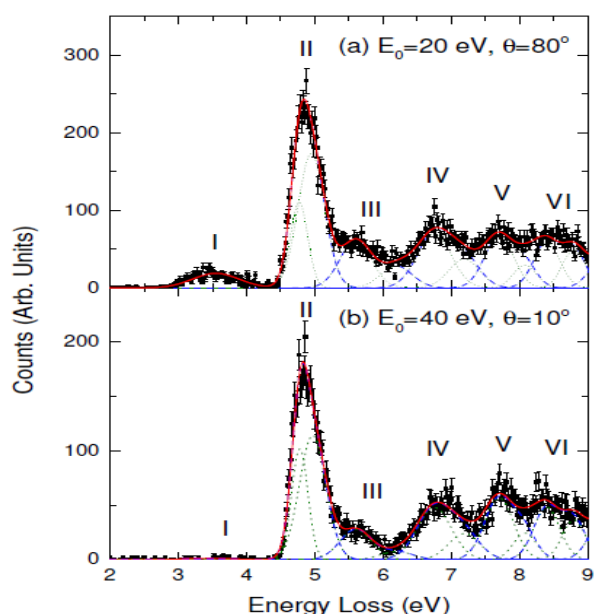


Figure 1. Typical electron energy loss spectrum of furfural at (a) $E_0 = 20$ eV and $\theta = 80^\circ$ and (b) $E_0 = 40$ eV and $\theta = 10^\circ$. The overall spectral deconvolution fit is denoted

References

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