Positron and Electron Scattering with Biological Molecules

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Synopsis Measurements will be presented for low-energy, high-resolution positron scattering from various biologically relevant molecules.

We will present our recent work on positron and electron scattering from biologically relevant molecules, such as nucleobases and their precursors. The work presented will show recent results from pyridine and thymine compared to previous measurements including uracil [1], water [2], formic acid [3] and pyrimidine [4].

Nucleobase molecules are solid at room temperature and thus require an oven to produce a vapour of the molecule for scattering experiments. The aim of this work is to provide absolute positron scattering information for the nucleobases and current efforts are predominantly focused on measurements of the grand total scattering cross section and the positronum formation cross section. Comparisons will be made between the available electron and positron scattering data, including our work in a number of other targets of interest.

The experimental measurements were carried out using the low-energy positron beam line at the Australian National University. The magnetically confined positron beam can be tuned from below 1 eV up to 200 eV with a variable energy resolution, which was typically between 60 and 100 meV. The operation of the beamline can also be modified to examine low-energy electron scattering with a similar energy width. Liquid targets with sufficiently high vapour pressure could be used with a room temperature scattering cell, while a vacuum oven was used to vapourise solid targets (see Figure 1). The oven temperature was monitored by using calibrated platinum resistive thermal devices (PRTDs) and controlled by varying a resistive heater (thermocoax) and the number density was determined via the vapour pressure curves for the target molecule combined with measurements of the oven temperature. Uncertainties in the temperature measurement and uncertainties in the vapour pressure curve constitute the largest systematic uncertainty with the uncertainty due to the statistical fluctuations in the measurement typically less than 3 %. The positron energy-loss spectrum can be used to determine the partial scattering cross sections. We will present details of the experimental procedure along with the design and operation of the oven based source.

The results produced for the various targets will be presented. In particular, the total and postironium formation cross sections for positron scatting from pyrimidine will be compared with measurements of pyridine and thymine. Elastic differential scattering cross sections will be compared for electron and positron scattering for pyrimidine and pyridine.

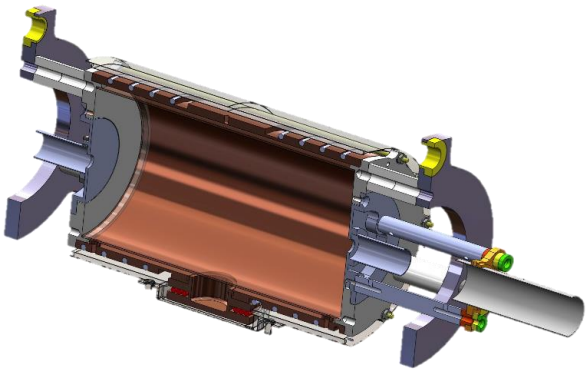

Figure 1. Vacuum oven used to vapourise targets which are solid at room temperature**.**

References

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