The Van de Graaff Era 4

Letter to Nature **276** (1978) 253

Detection of ^{14}C using a small van de Graaff accelerator

THERE have been several recent reports of the detection of ^{14}C in modern carbon samples using large van de Graaff accelerators[1-3] and cyclotrons[4] as mass spectrometers. The attraction of using such systems is the possibility that very small samples (~5 mg) might be quickly and accurately dated. We have considered the design criteria for a mass spectrometer incorporating a tandem van de Graaff accelerator to be built specifically for carbon dating and in this letter we present data which show that the measurements are possible using much smaller and simpler systems than those discussed previously.

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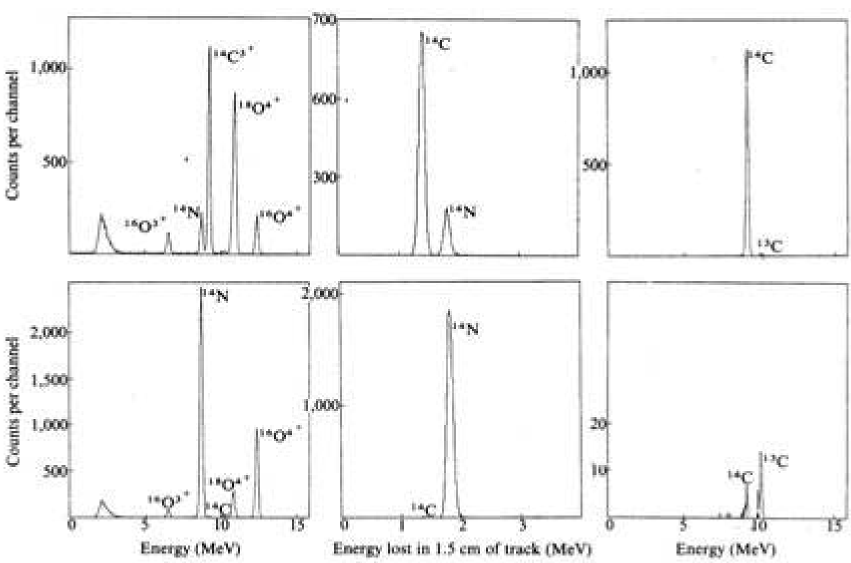


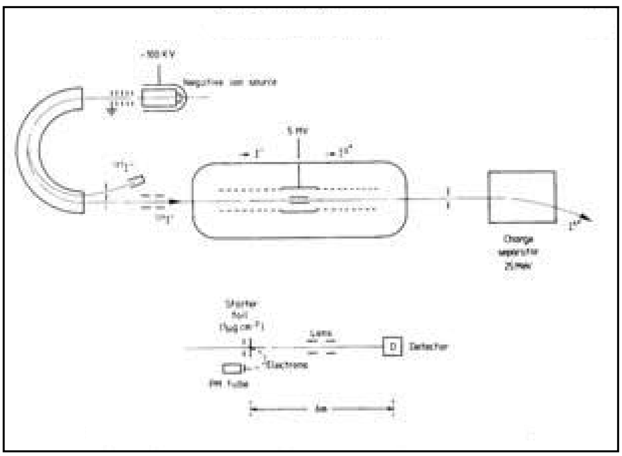
Fig. 4 Energy and energy loss spectra obtained for modern (top line) and old (bottom line) carbon samples. Left, total energy spectrum for carbon; centre, ΔE_2 for $^{14}N + ^{14}C$; right, total energy spectrum for carbon ions.

Following this experiment a successful proposal was made to equip the Research Laboratory for Archaeology at Oxford with a compact 2.5 MeV van de Graaff accelerator for use in ^{14}C dating.
The Turin shroud is among the many items the laboratory has examined

Heavy Isotope Accelerator Mass Spectrometry

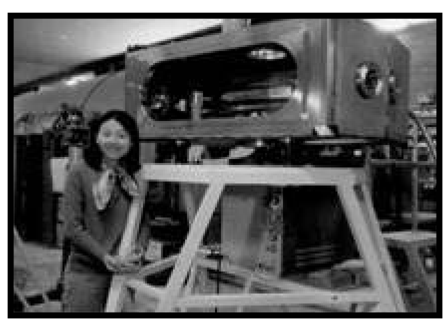
Nucl. Instrum. & Methods in Phys. Res. B5 (1984) p. 179

The Oxford Supersensitive Injector for Radioactive Isotope Separation (OSIRIS) was developed for the detection of heavy isotopes using the technique of accelerator mass spectrometry. The main elements of the system were the high mass resolution (M/ΔM=750) 180° injector magnet, the 5MV EN Tandem accelerator and the 20° electrostatic deflector which provided 'energy/charge' analysis for the accelerated beam. These elements, together with a time-of-flight detector, gave a resolution of ΔM=1 in the region of interest (A= 188-196). The isotopic ratios $^{194}Pt/^{195}Pt/^{196}Pt$ and $^{193}Ir/^{194}Pt/^{195}Pt$ were measured from the Cretaceous-Tertiary boundary at Stevns Klint, Denmark. The samples indicated an anomalous increase of Os, Ir and Pt at the CT boundary.



Schematic of the Osiris system

The Osiris injection magnet.



Dr H Chew with the electrostatic deflector of the Osiris experiment.

Nuclear Instruments and Methods in Physics Research B50 (1990) 197–207
North-Holland

NUCLEAR MICROSCOPY – ELEMENTAL MAPPING USING HIGH-ENERGY ION BEAM TECHNIQUES

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Using a scanned, focused MeV ion beam, the techniques of ion beam analysis can be used to obtain images showing two-dimensional elemental distributions. This technique of nuclear microscopy is important in applications where the distribution of elements within a sample must be related to optical or electron images showing the structure or functional organisation of the sample. With the techniques available at present, spatial resolutions of 0.5 μm can be achieved at currents allowing PIXE analysis of trace elements at the ppm level. The simultaneous use of particle backscattering analysis and secondary-electron imaging allows the light elements and the surface topography of the sample to be determined. In some cases, nondestructive three-dimensional elemental analysis can be carried out. This paper reviews the techniques and describes two applications in semiconductor physics and microbiology carried out using the facility at Oxford.

The Scanning Proton Microprobe (SPM) technique was pioneered at the Oxford Van de Graaff. A beam of 2 - 3 MeV protons is focussed to a sub-micron diameter spot - 300 nanometers has been achieved - using the low aberration , high precision quadrupole lenses developed in this laboratory by Geoff Grime and Frank Watt and shown in the photograph. As the spot is scanned over the target area the constituent elements of the target material can be identified by their characteristic X-rays (Proton Induced X-ray Emission or PIXE) or by Rutherford Backscattering (RBS).

A stand-alone facility based on a small accelerator funded by the Welcome Trust was inaugurated as an Interdisciplinary Unit in 1988 and demonstrated novel applications in a wide variety of research areas from a search for trace metals in senile plaques within the brain cells of Alzheimer's disease, to heavy metal take-up by certain fungi and micro-organisms, the micro analysis of the white pigments used by Rembrandt, and strain measurements in High Tc super-conductors.

In 2002 the Unit relocated to the Ion Beam Centre at the Physics Department of the University of Surrey.