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06/14

COMPLETE PELLETRON SYSTEMS FOR ION BEAM ANALYSIS

RBS ERDA PIXE NRA

NEC Model 3SDH, which includes a RF charge exchange source (alphatross), 3SDH Pelletron, analysis beamline, and NEC RC43 analysis end station.

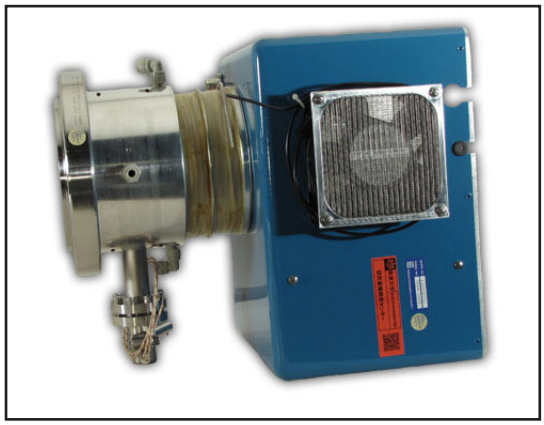
The typical Ion Beam Analysis (IBA) system from National Electrostatics Corp. is based on the S-series tandem Pelletron. These light ion systems range in potential from above 1 MV to above 2 MV. and are complete systems with all necessary hardware and software for RBS, channeling RBS, ERD, PIXE, and NRA. They are under full computer control for unattended, remote operation with all necessary hardwired and software interlocks.

The NEC IBA tandem Pelletrons are equipped with the model RC43 analysis end station. It includes a large 43 cm diameter chamber to allow the use of a wide variety of detector systems. An optional Gamma ray detector with reentry port can be added for NRA work. In addition, the system is equipped with a target manipulator which allows precise control of target movement in the X, Y and Z directions with polar and azimuthal rotation. This target manipulator is equipped with stepper motor controller and computer interface.

- **Rutherford Backscatter Spectrometry (RBS)**
- **Elastic Recoil Detection Analysis (ERDA)**
- **Particle Induced X-Ray Emission (PIXE)**
- **Nuclear Resonance Analysis (NRA)**

PELLETRON SYSTEMS

LIGHT NEGATIVE ION SOURCE (ALPHATROSS)



The NEC RF-charge exchange ion source (Alphatross) was designed primarily for the production of He^- beams for injection into tandem accelerators. Its use has been expanded to include H^-, NH^- and O^- beams. The source design was patterned after the RF-charge exchange ion source built and in regular use by Professor H.T. Richards at the University of Wisconsin - Madison, Department of Physics. The design has been continuously improved since its introduction on the S-Series tandem Pelletrons® in 1979. There are now more than one hundred NEC RF-charge exchange ion sources in use on tandem accelerators worldwide.

S-SERIES TANDEM PELLETRON

The S-Series tandem Pelletron accelerators have a rugged, voltage conservative design and incorporate all metal and ceramic high gradient acceleration tubes.

Model 3SDH: 1 MV tandem
alpha particles to above 3 MeV
Protons to above 2 MeV

Model 5SDH: 1.7 MV tandem
alpha particles to above 5.1 MeV
protons to above 3.4 MeV

Model 6SDH: 2 MV tandem
alpha particles to above 6 MeV
protons to above 4 MeV

The model 3SDH Pelletron is a 1 MV horizontal, tandem electrostatic accelerator designed to produce very stable beams of helium ions or protons. The light ion S-Series tandems are very voltage conservative. Lead shielding is incorporated directly on the pressure vessel to allow ease of access during most operational modes.

FULL COMPUTER CONTROL

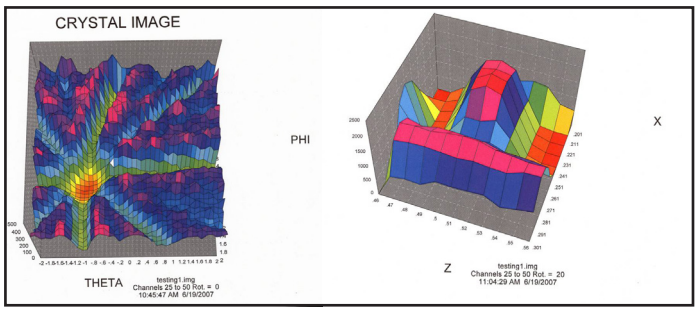
This photo shows the combined control console for the accelerator system and the analysis end station with the optional, large, multiple monitor system. Control and monitoring is done both by mouse, keyboard and computer assigned analog knob controls.

All of the parameters needed for routine operation of the IBA accelerator system are available at a single control console (at left). Accelerator parameters are interfaced to a local controller which is connected to the next station in line or to the microcomputer by fiber optic link. A comprehensive interlock system is provided to protect both personnel and equipment. The Pelletron is protected against overheating, insufficient tank pressure, power failure and vacuum failure. The system is designed for true unattended operation. The vacuum system is monitored by the computer control system; however, it is fully interlocked via hardwire.

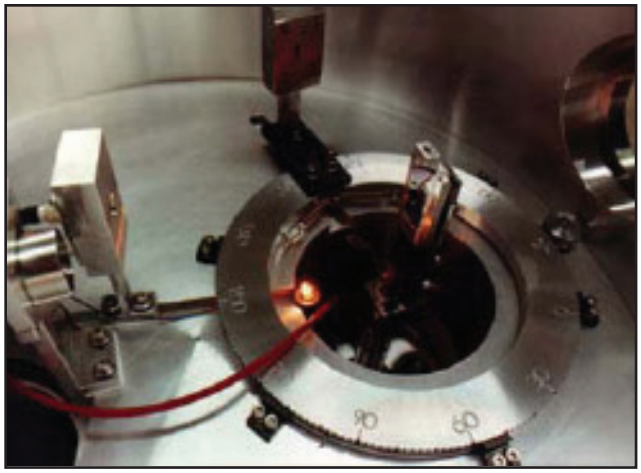
ION BEAM ANALYSIS END STATION

RC43 SYSTEM

The NEC RC43 Analysis End station combines several complementary materials analysis ion beam techniques with automation software to yield a fast, complete, and verified materials analysis answer to your unknown targets. The analytical techniques include Rutherford Backscattering (RBS) with Channeling, Elastic Recoil Detection (ERD), Particle Induced X-Rays (PIXE), and Nuclear Reaction Analysis (NRA). In one data collection pass all elements can be identified and depth profiled. The software allows all the techniques to be simultaneously "live". Also, the RC43 generates mappings of surface elemental concentrations and crystal structure as images yielding a true 3D analysis (below).

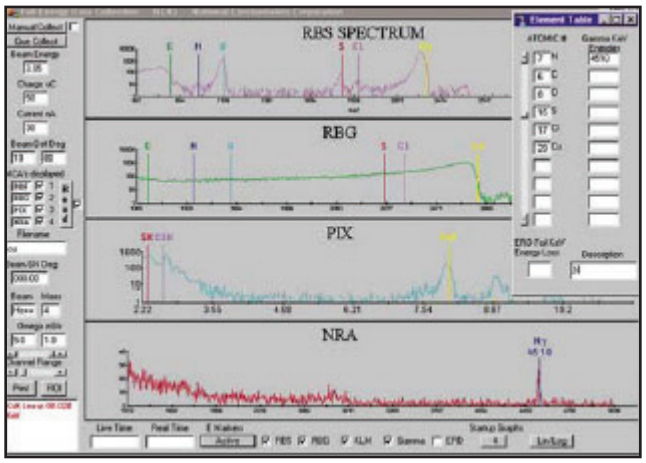


CHAMBER



Inside the high vacuum chamber you can see the detectors, beam collimation, filters, and target positioning device. The chamber is electrically isolated and made of a mono elemental metal to eliminate or reduce background noise. Filter and sample positioning are remotely controlled. A video camera allows the operator to position targets for analysis from the console. The target position is then put in a queue for subsequent unattended data collection. A group of targets can be changed in only a few minutes through a load lock. Easy and safe use of load lock valves, etc. is accomplished by a vacuum interlock controller.

SOFTWARE



The RC43 software has four data collection windows. It displays elemental markers for each detector during data collection. Elements are easily added or removed from the list. The control software not only automates data collection and qualitative analysis, but also requests experimental beam parameters from the accelerator controller. Instructions can also be sent to the accelerator for real time control required for doing accurate depth profiles using nuclear reactions. Other software packages such as RUMP and GUPIXWIN are integrated for accurate quantitative analysis.

System Control and Materials Analysis Software

The NEC IBA Pelletron systems have dedicated software for accelerator control and dedicated software for data collection and analysis. These two software systems are fully integraded to allow unattended data collection. In addition, there is an array of hardwired and software interlocks, some of which can be used by the customer to interlock laboratory doors and other related system.

ACCELERATOR CONTROL

The accelerator control system software is based on Scientific Linux with X-Windows and the NEC AccelNET software. AccelNET displays parameters in multiple Windows for both text formatted pages of parameter lists and graphic displays of the system layout. The accelerator control adjustment can be done by restoration of stored values, by increment/decrement buttons, keyboard input, and by computer assigned analog knobs. Most parameters needed for beam transport can be controlled from a single Window. Multiple Windows allow convenient set up, fine tuning, data display and other custom displays.

DATA COLLECTION AND ANALYSIS CONTROL

The RC43 Analytical Data Collection software collects data from four detectors simultaneously, capturing RBS, glancing RBS (or ERD), PIXE, and NRA readings. The data is computer analyzed to yield a fast, verified, complete real time materials analysis of the sample. To assist the operator performing crystalline or elemental mapping analysis, the software also prints plots of channeling and microprobe data.

Data Collection with this software is made easy by setting up sample queues for unsupervised or “in background” data collection runs. Crystal axial channel locations are found automatically from polar scans and then loaded into the sample queue for use during the subsequent data collection runs. Spectral peaks from all detectors are identified via an element table. Chi-min and half angle crystal parameters are determined with the click of a button.

The RC43 software communicates with the accelerator control system receiving information and sending instructions to produce the optimal beam conditions during real time runs. The RC43 Analytical Data Collection software automatically saves the data it collects and makes it ready to be utilized in quantitative analysis programs such as RUMP, GUPIXWIN and Alegria. The analysis programs run in the Windows environment.

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