NUCLEAR ANALYTICAL FACILITIES AT TEXAS A&M UNIVERSITY

W. D. JAMES, J. B. SHAPIRO, E. A. SCHWEIKERT

Center for Chemical Characterization and Analysis, Department of Chemistry, Texas A&M University, College Station, Texas, 77843-3144 (USA)

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Nuclear Analytical Chemistry at Texas A&M University is based in large part on the facilities of the Center for Chemical Characterization and Analysis and the Nuclear Science Center. This paper describes the capabilities of these two centers for instrumental and fast neutron activation analysis, neutron depth profiling, prompt gamma activation analysis, neutron radiography and the unique features of the large volume irradiation cell and reactor pulsing operation.

Two of the most widely used nuclear analytical facilities at Texas A&M University are the Center for Chemical Characterization and Analysis and the Nuclear Science Center. Both facilities provide services to a variety of university users.

Center for Chemical Characterization and Analysis

The Center for Chemical Characterization and Analysis (CCCA) operates an Elemental Analysis Laboratory which provides a wide range of neutron activation and x-ray fluorescence services to university users, government agencies and industrial customers and collaborators.

The CCCA operates three small accelerating devices for the production of high energy neutrons. A Cockcroft Walton positive ion accelerator (pump-down variety) is now used primarily for non-analytical research. Two sealed-tube neutron generators are used for fast neutron activation analysis (FNAA). The generators are installed in the same room in a configuration such that they can be used independently or together for irradiation chores. Sample transfer hardware and control software operate on associated computers for the automated oxygen analysis procedures.

The dominant use for our fast neutron facilities is for the determination of oxygen in a wide variety of materials.\(^{1}\) Oxygen measurements are based on the \(^{16}\text{O}(n,p)^{14}\text{N}\) reaction, resulting in the emission of high energy characteristic gamma rays of the short-lived product. Samples, standards, blanks and quality control vials are irradiated sequentially while neutron beam fluctuations are monitored and normalized by use of a BF\(_3\) detector. Counts associated with the BF\(_3\) monitor during the irradiation and NaI(Tl) scintillators detecting the \(^{14}\text{N}\) gamma radiations during the counting period are input into a multichannel scaling analyzer. The resulting complex spectrum (Figure 1) for each sample is evaluated by comparison with standard spectra for oxygen content determinations. Sample vials are routinely analyzed using five replicate irradiation/counting sequences.

In addition, major/minor elements, especially silicon and nitrogen, are routinely analyzed with FNAA. Recent emphasis has been directed towards the development of fast neutron probes for characterization of sites contaminated with metals either on the soil or buried under the surface.
Typical multichannel scaling spectrum for oxygen determination using fast neutron activation analysis.

In addition to FNAA, several tens of thousands of determinations are performed using instrumental neutron activation techniques at the Center each year. The CCCA maintains several high resolution germanium gamma spectroscopy systems both on campus and at the Nuclear Science Center. Two systems are used in conjunction with automated sample changer hardware which allow unattended 24 hour operation. Peak analysis and NAA calculations are done using Canberra Nuclear Data software running on the facility's VAXstation II/GPX.

Primary usage is by university departments, often with the Center providing instrumentation and methods expertise while the individual researchers do much of their own hands-on work. A small technical staff provides service analysis to government and industrial users who make use of our capabilities. Some larger university users include:

a. Animal Science Department - animal nutrition using stable rare earth markers
b. Geology Department - rock/soil characterization, KT boundary studies, diagenesis investigations

c. Oceanography - marine organism characterization, sediment transport in the Gulf of Mexico

d. Chemistry Department - characterization of catalysts, reaction product stoichiometry

e. Horticulture Department - plant physiology, monitoring of environmental contaminants with epiphytes.

Nuclear Science Center

Instrumental neutron activation analysis performed by the CCCA employs the irradiation facilities of the Nuclear Science Center (NSC) at Texas A&M University. The NSC operates the University’s research reactor, a 1 MW TRIGA facility with pneumatic and