**Steacie Institute for Molecular Sciences**

**Neutron Program for Materials Research**

# Powder diffraction neutron services offered to academia and industry

## Scattered Neutrons Never Lie!

*He who obtains has little . . .*
*He who scatters has much.*
*- Lao Tzu*

**Crystallography**
**Site Ordering**
**Bulk Materials**
**In-situ Experiments**
**Light Atoms**
**Structural Properties**
**Quantitative Phase Analysis**

NEUTRON FACT SHEET #7

Powder Neutron diffraction can be a powerful analytical method in understanding the crystalline properties of materials under ambient and non-ambient conditions.

They can handle large volumes of material allowing you to be confident that you are using a representative amount of sample (greater than half to several cubic centimetres).

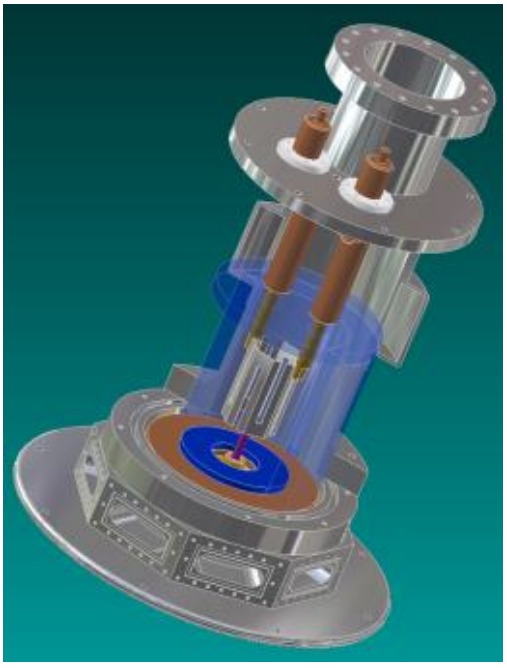

Figure 1: High temperature furnace (Room Temperature to 1800°C)

Figure 2: Vanadium cans used for containing powder samples

It is very good for quantitative analysis and assisting in the validation of X-ray diffraction results

Powder X-ray diffraction is commonly used for crystallographic characterization of materials, but neutron diffraction has several advantages and features:

Neutrons are sensitive to light elements such as oxygen and including hydrogen / deuterium. Structural changes that show little effect with X-ray diffraction methods can show major changes with neutron diffraction Fig. 3. (However, some elements are not suitable for use with neutron diffraction due to

absorption or poor scattering. These are cadmium, boron, gadolinium and vanadium.)

Due to the great penetrating power of neutrons, they can handle complicated sample environments and allow you to look at the full sample. Reliable stages are available at the NMPR for low temperature work down to 1.8 K; high temperature up to 1900ºC; as well as options such as in-situ environments (gas pressurization and mixing, following reactions in real time etc.) User specific experimental equipment can be manufactured at the laboratory. This is in contrast to X-ray diffraction where you are often just looking at the surface of the sample.

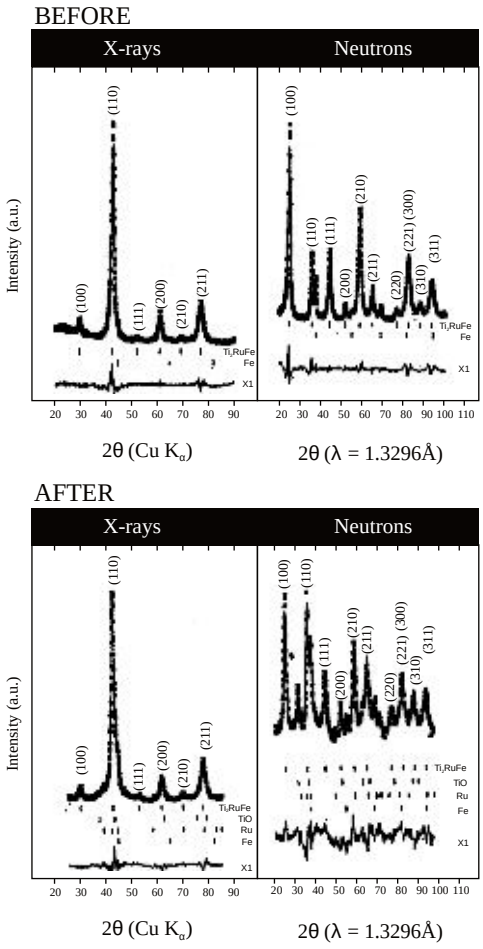


Figure 3: Spot the difference - Cathode material with and without oxygen


Figure 4:
C2 Neutron Diffractometer.

*800-wire $BF_3$ position sensitive detector.*

*0.1° Wire spacing.*

*80° of scattering angle measured simultaneously.*

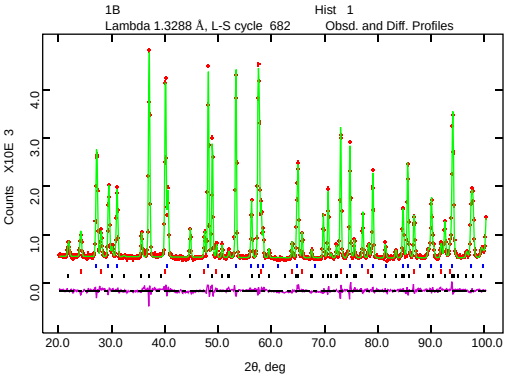


Figure 5: Superior results from quantitative phase analysis using neutron diffraction

The C2 neutron powder diffractometer has a reputation of being a friendly and effective Canadian and international user facility. Computer controlled equipment allows for the setup and automatic running of experiments remotely from the spectrometer if necessary.


For more information contact:
Alastair McIvor

National Research Council Canada
Chalk River Laboratories
Chalk River, Ontario
Canada, K0J 1J0

Phone: 1 (613) 584-8811 x6274
1 (888) 243-2634
Fax: 1 (613) 584-4040
E-mail: Alastair.McIvor@nrc.gc.ca

http://neutron.nrc.gc.ca


NEUTRON FACT SHEET #7