UVic KNOWLEDGE
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Radical research with magnetic molecules

by Dana Codding and Monique Jacobs

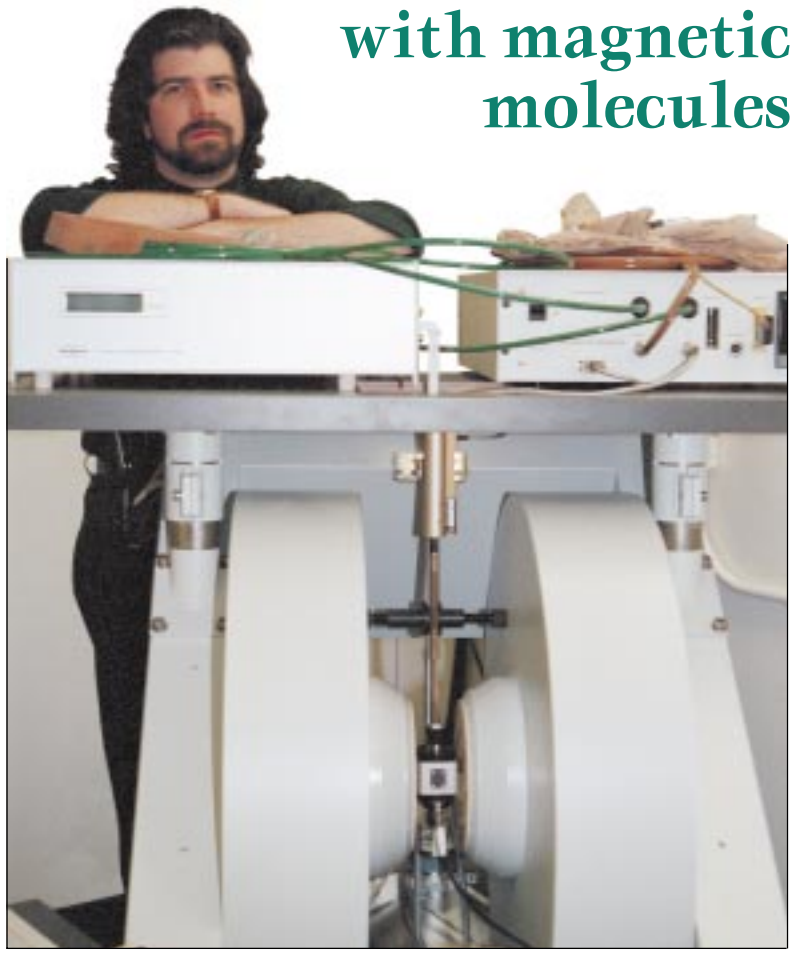
UVic researchers are now able to "see" the magnetic properties of molecules, gathering information useful in a wide range of fields, from creating advanced magnetic materials to developing novel cancer treatments.

This new line of research is being pursued by a team of UVic scientists headed by chemistry professor Robin Hicks using an electron paramagnetic resonance (EPR) spectrometer purchased with a grant from the Natural Sciences and Engineering Research Council of Canada (NSERC).

The EPR spectrometer is designed to detect radicals, which are molecules that have unpaired electrons. Electrons, which are small spinning electrical charges, usually travel in pairs. In radicals, the lone electron creates a magnetic force as it moves around the molecule. By applying a field of electromagnetic energy to a very small sample of material, the EPR spectrometer can produce a "spectrum" which is unique for every kind of radical and provides information on the location of the unpaired electrons within a molecule and the magnetic properties of molecules or solids.

The new spectrometer replaces two 20- to 25-year-old spectrometers made obsolete by advances in computer technology. "Unlike the older models, the new EPR spectrometer has a computer and analytical software built-in, which will let us run much faster and more accurate experiments," Hicks explains. The new spectrometer is also much more sensitive, allowing even smaller quantities of material to be studied than before.

Hicks and his three graduate students study stable radicals. Normally, radicals are so reactive they can't be captured before they disappear, but certain kinds — called "stable radicals"— can actually be put in bottles and stored. The spectrometer is leading Hicks to new insights into why they are so stable.



Hicks and the EPR spectrometer

"We don't really know a lot about the basic properties of stable radicals," Hicks said. "We're trying to find out what happens to their properties when a small change is made to the structure of the molecule."

Hicks and his students are making new kinds of stable radicals and studying their EPR spectra at different temperatures. These may be prototypes for new kinds of large molecules, or polymers, with many unpaired electrons that have novel magnetic properties.

Another UVic scientist who will benefit from the new EPR spectrometer is biochemistry and microbiology professor Tom Buckley. With the help of two grad students, Buckley researches hole-forming proteins. These proteins group together to form aggregates that puncture the outer layer, or membrane, of target bacterial cells, as well as animal and plant cells. For example, T-cells in our immune systems produce hole-forming proteins to kill invading bacteria. "This is the most common way that cells kill other cells," Buckley says.

Buckley attaches stable radicals to the proteins and uses the EPR spectrometer to track their movements as the proteins group together. The movements of the radicals tell him how the proteins join and how they puncture the membrane of the cell. Once scientists know how and why the proteins group, they can use this information in designing proteins for specific applications, such as killing cancer cells or preventing the spread of HIV.

EDGE/WISE Keeping flavours fresh

EPR spectrometers like the one at UVic have been enlisted recently in monitoring flavor stability in beer and other foods.

"The foul odor and taste of stale beer comes from chemical reactions that produce radicals," says UVic chemistry professor Robin Hicks. He explains that the disagreeable flavor and smell is caused by the compounds formed when these radicals decompose. Part of the reason beer should be refrigerated is because the rate that radicals decompose depends on the temperature at which the beer is stored. Often, additives in the beer are used to slow down the radical-generating reactions, explains Hicks.

Beer manufacturers use EPR spectrometry to detect radicals and monitor the process of decaying flavor. This enables brewers and other food manufacturers to predict the expiration date of the product and how long it will last on the shelf or in a refrigerator.

SHARPEN YOUR KNOWLEDGE

• Dr. Robin Hicks' Web site has more information about his work with stable radicals. **www.chemistry.uvic.ca/hicks/hicksrad.htm**

• Ever wonder how someone discovered a particle so small that nobody had ever seen it? The Centre for the History of Physics and the American Institute of Physics have an on-line exhibit on British physicist J.J. Thompson and his experiments in 1897 that led to the discovery of a fundamental building block of matter. Visit: **www.aip.org/history/electron/**

• Dr. Hideki Shirakawa (University of Tsukuba, Japan), Dr. Alan Heeger (University of California at Santa Barbara), and Dr. Alan MacDiarmid (University of Pennsylvania, Philadelphia) were awarded the 2000 Nobel Prize in Chemistry for the discovery and development of conductive polymers — plastics that conduct electricity like metal. Visit: **www.nobel.se/announcement/2000/chemen.html**

FACTS FROM THE EDGE

• UVic ranks number one among comprehensive universities in the number and dollar value of research grants in sciences and medicine per eligible faculty member.*

• UVic ranks third among comprehensive universities in the number and value of research grants in the social sciences and humanities per eligible faculty member.*

* Source: *Maclean's* magazine annual research rankings of Canadian universities (20 Nov. 2000)

ON THE EDGE OF YOUR SEAT

The Gesher Project
An inter-generational Holocaust exhibit of mixed-media paintings
through Jan. 12, 2001
Maltwood Art Museum & Gallery
Info: 721-8298

"Leif the Lucky One"
Three performances by Helga Arnalds of her one-woman puppet theatre production based on the Icelandic sagas
January 14, 2–3 p.m.,
St. Albans Hall, 1468 Ryan Street
January 15, 12–1 p.m., Philip T. Young Recital Hall, MacLaurin Music Wing
January 17, 12–1 p.m., Philip T. Young Recital Hall, MacLaurin Music Wing
Free and open to the public.
Info: 853-7656

For further information, visit the online events calendar at **www.uvic.ca/events**

SPARK

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