Bruce Cowie inspects the soft X-ray beamline at the Australian Synchrotron.

Soft X-rays: The Swiss Army Knife of Synchrotron Light

The new soft X-ray beamline at the Australian Synchrotron will be contributing to a greener Australia, with users looking at soil structure and "paint-on" solar panels.

While "soft" may sound like an odd term for X-rays, it describes their low energy, not their application, according to the scientist in charge of the beamline, Bruce Cowie: "They are the Swiss Army knife of synchrotron radiation because they can be used for so many things". In particular, Cowie says that soft X-rays are good for investigating the chemistry of surfaces, and also the bonding patterns of the smaller and lighter elements from which living organisms are built.

Throwing Dirt at the Synchrotron

Cassandra Schefe hopes to throw all sorts of dirt at the soft X-ray beamline. A soil chemist with the Future Farming research division of the Victorian Department of Primary Industries at Rutherglen in north-eastern Victoria, she has become one of the first researchers in her field to use the power of a synchrotron to investigate soil chemistry.

"Studying soil chemistry has always been a bit of a challenge because the techniques available were largely limited to wet chemistry – measuring compounds in solution. That gave you a snapshot of what was there, but no indication of how and why it came to be there. Using the synchrotron you can actually look at how nutrients bind to the soil and think about how to change that binding."

That's important when dealing with fertilisers. While crop productivity and the world's food supplies are now highly dependent on fertilisers, their use contributes to greenhouse gas emissions and can also lead to problems with high nitrogen and phosphorus levels in rivers and lakes. What's more, the fertiliser applications are becoming increasingly expensive.

All of this adds to the importance of Schefe's studies on how phosphorus is taken up and released in acidic soils – about half the arable soils of the world. "We are collecting soil from acidic cropping areas and loading it with different amounts of phosphorus in different forms to study the interactions between soil particles and fertilisers. We can also look at how different formulations affect the availability of fertilisers to plants."

So far Schefe has used synchrotrons in Canada and Switzerland, but she is very much looking forward to her turn on the beamline in Melbourne. "I'm hoping it will encourage synchrotron research throughout the Department. Having such a tool close by takes away the 'It's all too hard...' excuse, and breaks down barriers."

Paint a Solar Panel on your House?

"Thin, cheap, transparent or translucent films and paints could become alternative, sustainable sources of energy," says Paul Dastoor from the University of Newcastle. Dastoor and his team are developing polymer coatings that act as photovoltaic cells and generate electricity.

The solar cells they make will probably comprise a mixture of polymers, which Dastoor says means that "they will separate like oil and water. To optimise our devices we will have to make sure that segregation is neither too much nor too little."

Synchrotron soft X-rays have just the right energy to analyse carbon and provide his team with the ability to look at the composition and structure of the films they produce.

Dastoor has worked extensively on synchrotrons in Taiwan, the US, Japan and Korea. Having a synchrotron in Australia is crucial to his work, Dastoor argues, as flying with samples to use instruments overseas is a high-risk strategy.

The synchrotron in Melbourne will reduce time and costs so much that his students will be able to use it as a research tool. He already has procured and commissioned a complete new surface-analysis workstation for his laboratory that matches the equipment at the Australian Synchrotron and allows his research team and others to test-drive experiments before taking them to Melbourne.

Visit www.synchrotron.org.au for more information.