EPDIC17
Šibenik.Croatia. 26-30 May 2020.

PLENARY LECTURE

The history, development, highlights and future possibilities for synchrotron X-ray powder diffraction

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The use of synchrotron radiation (SR) to collect high quality powder diffraction data for solving problems in engineering; physics; chemistry; materials and the biological sciences is now so commonplace that researchers regard modern SR sources an extension of their own labs.

However the use of this now ubiquitous tool is a relatively new development. In the 1970s and early 1980s there were just a handful of scientists who used SR from high energy physics machines in a, so called, parasitic mode. I prefer symbiotic mode because it later benefitted both communities. In the mid-1980s a range of purpose built user facility SR sources sprang up specifically for the production and use of SR. The first dedicated user SR source capable of producing X-rays was the SRS at Daresbury Laboratory in Cheshire UK. There followed many improvements to lattice design that led to higher quality machines in many countries; there are now well over 70 sources worldwide. We are now witnessing the construction of a new generation of ultra-high brightness diffraction limited sources, for example at ESRF with the extremely Bright Lattice (EBL). Selected developments and technical challenges will be described.

In the early days of SR it was recognised that the high brightness, tunability and natural collimation of the light would all be highly beneficial for powder diffraction. Early attempts at structure solution and refinement will be discussed. In parallel, powder methods were developed for high pressure studies; for studying in-situ reactions; for amorphous and complex biological materials; for thin films and stress studies and more latterly for imaging.

The combination of diffraction and 3D reconstruction methods will also be discussed together with examples of use in catalysis, non-destructive testing and materials research. The history, instrument science and selected key scientific results will be discussed in the context of the history of the subject.