Poster

Hands-on, challenge-based teaching in crystallography undergraduate practicals

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Following a need for increased hands-on experience with technical analytical instrumentation for undergraduate students, the University of Southampton has offered just such a practical course to third year students for the past 10 years. This involves the preparation of crystalline materials, with subsequent analysis including the collection of single crystal X-ray diffraction data and work-up to generate fully refined crystal structures.

Over those years the practical has steadily evolved. Thus, the first practical [1], which was predominantly a 'cookbook' exercise, has now been superseded by a problem-led challenge. Students are presented with a marketplace of co-formers and tasks them to modify the physical properties of an API to be within a particular set of requirements. However, many of the fundamental principles of that original practical persist - ensuring students independently conduct all analyses (with no 'black box' results) to gain applied hands-on experience of a range of solid-state analytical methods, using cheap, safe and readily available chemicals.

The practical can be offered multiple times throughout the year but is designed to run for one day a week over a three-week period, which has given the potential for a more project-based exercise to be developed. Several individuals, or pairs, conduct the practical simultaneously, with a class size of up to 10 students. We show that this number of undergraduate students can grow a range of good, suitably sized crystals in a week, for which publication quality datasets can be collected on a benchtop sealed tube diffractometer with a CCD detector in an hour (or less). The practical also involves complimentary powder diffraction, hot-stage microscopy and infra-red techniques, which are all housed in the same space. Logistically, this enables not only a range of different experimental activities, but also the ability to gather results, reflect and take the work in a different direction in a subsequent session.

We will present the current practical but also reflect on how it has changed (including the influence of conducting it under pandemic conditions) and show what has worked well and what has not worked so well.

[1] Coles, S.J. and Mapp, L.K., Conducting Reflective, Hands-On Research with Advanced Characterization Instruments: A High-Level Undergraduate Practical Exploring Solid-State Polymorphism, J. Chem. Educ., 2016, 93, 131–140.