Poster

A systematic study of crystal size influence on Crystal Sponge experiment outcomes

T.F. Alotaibi[1], S.J. Coles[1]

[1]*School of Chemistry, Faculty of Physical Sciences and Engineering, University of Southampton, Highfield, Southampton, UK*

t.alotaibi@soton.ac.uk

The Crystalline Sponge (CS) method uses nanogram to microgram quantities of an uncrystallisable compound, such as an oil, to soak into a porous crystal; the combined crystal structure of the host and the 'uncrystallisable' guest can then be characterised by Single Crystal X-Ray Diffraction (SCXRD) to reveal the molecular structure of the analyte [1].

When considering the range of factors that influence the process of analyte soaking into the host framework and the quality of the subsequent result, the nature of the sponge crystal is critical [2]. A SCXRD experiment is performed upon the entire CS and so results are observed where some pores are occupied with guest analytes in different positions, some pores have no analyte or might be blocked and some are full of solvent molecules. Consequently, this breaks the overall order of the crystal and has detrimental effects on diffraction due to this extreme 'disorder'. Controlling the analyte diffusion, or soaking, process is the key to obtaining a greater number of occupied pores, and crucially with a more even distribution of analytes.

Although a rapid soaking process may result in some analytes successfully diffusing in to the host, this may lead to blocking of inner pores in the crystal. Hence, if a microcrystal sponge is used and has the same soaking conditions, in theory there will be a greater proportion of pores occupied by the analytes compared to a macrocrystal sponge. Microcrystalline sponges have therefore been employed in a number of soaking experiments in our laboratory, but despite using ultra-high flux rotating anodes, proved to be rather challenging for analysis using in-house diffractometers in terms of data quality, accurate space-group determination and a lengthy data collection time. According to Clardy *et al*., these issues can be simply resolved by using synchrotron radiation, where data can be collected in less than an hour and crystal diffracting power is less of a problem [3].

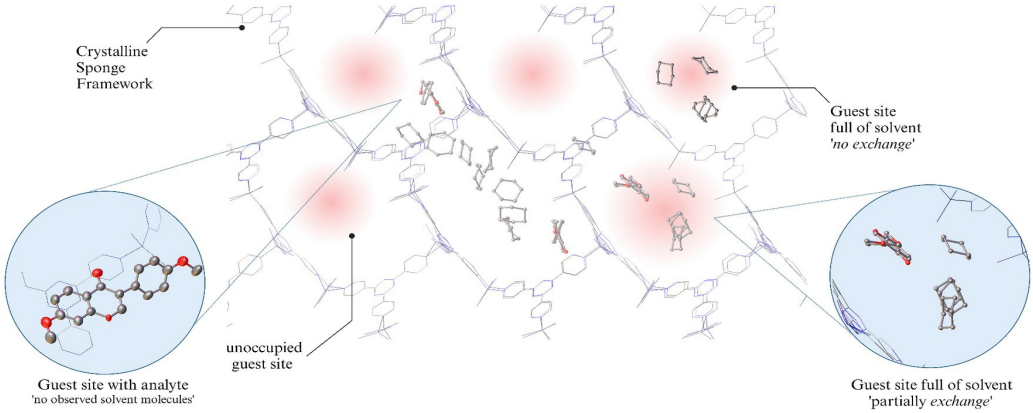

Figure 1. Schematic of solvent exchange in the crystalline sponge method, showing states ranging from unoccupied to partial or full exchange of solvent with target analytes

This work therefore reports the undertaking of a statistical design of experiment (DoE) study to investigate the effect of a relative decrease in microcrystalline sponge size on the successful outcome of soaking and crystal structure determination. The standard crystal sponge is 100 – 250 μm^3 and this work systematically extends the size regime to explore the effect of employing smaller crystals [(90 × 80 × 70 μm^3), (70 × 60 × 50 μm^3), (50 × 40 × 30 μm^3) and (30 × 20 × 10 μm^3)]. High-flux synchrotron radiation (Diamond Light Source, Beamline I19) enables the successful collection of data from these microcrystals and the results of a systematic study will be presented. Further, Rigaku Synergy-ED instrument was recently installed in our laboratory and so provides an extension to this work by studying soaking and results quality in nanocrystals and some early findings will be presented.

[1] Y. Inokuma, S. Yoshioka, J. Ariyoshi, T. Arai, Y. Hitora, K. Takada, S. Matsunaga, K. Rissanen and M. Fujita, Nature, 2013, 495, 461–466.

[2] M. Hoshino, A. Khutia, H. Xing, Y. Inokuma and M. Fujita, *IUCrJ*, 2016, **3**, 139–151.

[3] T. R. Ramadhar, S. L. Zheng, Y. S. Chen and J. Clardy, *Acta Crystallogr A*, 2015, **71**, 46–58.