How can high brilliance beamlines serve the soft matter community?

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X-ray scattering and diffraction are firmly established methods for unraveling the structural secrets of condensed matter, including polymers and other soft materials. Still, there are massive on-going efforts towards radical improvements in brilliance and experimental designs, enabling novel techniques for understanding the structure and function of materials, composites and devices. Radiation damage is a key challenge when studying organic materials [1], and it is an important question how further increases in brilliance can be fully exploited to the advantage of soft matter science. In this talk, I shall present some of our recent experiments directed towards quantitative and time-resolved X-ray scattering-based studies of soft and bio-related materials. Examples include 3D microscopy of mineral composition and hydroxyapatite orientation in fossil bone samples based on diffraction contrast [2], and time-resolved experiments ranging from quasi-static X-ray ptychography studies of silk fiber hydration [3], via *in situ* CT studies of cement exposed to CO_2 [4], to ultrafast tracking of acoustical phonons in molecular films [5]. A shared feature of many new microscopy schemes is that computers are used not only for post-capture image analysis, but also increasingly in the image-forming process itself – potentially opening for faster reduced-dose experiments. Implications of future higher brilliance X-ray beams, promising investigations of yet faster dynamics and finer structures, will be discussed.

References

[1] ETB Skjønsfjell, Y Chushkin, F Zontone and DW Breiby.
J Synch Rad **25** (2018) 1162-1171
[2] FK Mürer, S Sanchez, M Álvarez-Murga, M Di Michiel, F Pfeiffer, M Bech, DW Breiby.
Scientific Reports **8** (2018) 10052
[3] M Esmaeili, JB Fløystad, A Diaz, K Høydalsvik, M Guizar-Sicairos, JW Andreasen, DW Breiby.
Macromolecules **46** (2013) 434
[4] EA Chavez Panduro, M Torsæter M, K Gawel, R Bjørge, A Gibaud, Y Yang, S Bruns, Y Zheng, HO Sørensen, DW Breiby.
Environmental Science & Technology **51** (2017) 9344-9351
[5] HT Lemke, DW Breiby, T Ejdrup, P Hammershøj, M Cammarata, D Khakhulin, N Rusteika, SI Adachi, S Koshihara, TS Kuhlman, S Mariager, TN Nielsen, M Wulff, TI Sølling, N Harrit, R Feidenhansl, MM Nielsen.
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