Bragg ptychography: recent results and perspectives at fourth generation synchrotron sources

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Ten years ago, we have proposed to develop Bragg ptychography [1] as a 3D microscopy approach dedicated to crystalline materials. These efforts were motivated by the robustness of the method with respect to highly non-homogeneous strain fields, by the high sensitivity to displacement fields, the high 3D spatial resolution and the possibility to image extended crystalline samples, pushing further away some of the limits met by finite-support based Bragg coherent diffraction imaging and transmission electron microscopy. Despite strong difficulties linked to the specific geometry of Bragg diffraction, several 3D Bragg ptychography experiments have been successfully performed on *e.g.*, biominerals at ID13-ESRF [2], phase domain boundaries at ID01-ESRF [3], stressed semiconductors at HXN-APS [4], quantum wires at HXN-NSLS2 [5], etc.

However, Bragg ptychography remains difficult to use as a routine process at synchrotrons, because it requires probe-to-sample stability over several hours combined with a fine angular exploration of the 3D intensity pattern. The inversion process involves the handling of a large 3D data set in a non-orthogonal frame, which is counter-intuitive and computing demanding.

Over the past years, strong efforts have been made at synchrotrons to promote this approach, including experimental designs and software developments. They come together with several propositions aiming at relax some of the experimental constraints, such as pre-knowledge of probe, regular angular sampling, fine angular steps, etc. Those improvements, together with the advent of fourth generation synchrotron sources, make now possible the acquisition of a full set of Bragg ptychography data in less than 30 min. These pave the way to the systematic investigation of complex crystalline systems and to the temporal follow-up of physical processes.

This talk will review the main progresses made by Bragg ptychography over these ten years and present some of the exciting perspectives offered by the advent of fourth generation synchrotron sources.

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References

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