Study the hierarchical structure of materials by scanning Micro/Nano diffraction

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The upgrade of synchrotron facilities and the development of X–ray optics allow focusing X–ray to Micro even Nano size with extreme brilliance. This enables various high–resolution X–ray imaging techniques, for instances basing on diffraction, or phase contrast or fluorescence. Here, I will detailed discuss a diffraction based X–ray imaging techniques, scanning X–ray microdiffraction (SXM), which could resolve the hierarchical structure of materials. Two applications are exhibited here. Firstly, SXM reveals the effect of morphological structure on its molecular and meso structural variations within regenerated cellulose fiber. This enables understanding of the correlation between the structure of fiber and its mechanical properties. Besides, SXM has also been used to determine the crystal phase transition and component changes during the glass corrosion. The structure of emergent second phase of surface layer of hydrolysis corroded glass, usually size of micron or sub–micron, could only be resolved by SXM. In addition, I would like to discuss the implements of SXM at Nano beamlines at European Synchrotron and the data processing of SXM. SXM could produce thousands even millions image during one beamrun. The efficient data processing and visualization is essential for understanding the scientific meaning within SXM data. I will provide a brief review on current data processing tools and introduce a customized developed data pipepline for SXM data of ID, ESRF. In sum, SXM is a powerful technique to study the multiscale structure of materials and there could be a greater potential to monitor the progress of structural variation by incorporating in–situ and in–operando methods with SXM.