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Biomedical Imaging Applications of X-Ray Diffraction

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The use of x-ray diffraction optics for biomedical imaging has provided a very fruitful area of instrumentation development, especially at synchrotron sources. Such optics have driven a number of biomedical imaging applications such as K-edge subtraction imaging (a form of element specific imaging), analyzer based imaging or diffraction enhanced imaging, Talbot or interferometry based imaging and in-line phase contrast imaging. The biomedical beamline at the Canadian Light Source provides an ideal environment to develop and test new optical systems with the motivation to provide new tools for the biomedical community. Our group is actively involved in all aspects of optical system development and application. Recently, we have developed a new "spectral"approach to K-edge imaging that may soon lead to rapid 3D imaging of a contrast element including the potential for speciation imaging. We have developed x-ray optics that angularly disperse a wide range of continuous imaging energies for multi-elemental analysis (˜12keV range centered at 35keV) and imaging at several specific energies simultaneously (multiple energy imaging). Most recently, we have explored ways to very efficiently expand our imaging beam vertically to better match the size of the subjects. An interesting aspect of the optic is that provided a vertical beam size that would have been possible with a beamline 12 times longer than the actual length of 25m. This allows us to much better utilize the intensity of the synchrotron beam and will lead to a unique capability for dynamic imaging. Examples of all of these developments and their application will be presented along with a future perspective will be given.

Author: CHAPMAN, Dean (University of Saskatchewan)

Co-authors: BASSEY, Bassey (University of Saskatchewan); MARTINSON, Mercedes (University of Saskatchewan); SAMADI, Nazanin (University of Saskatchewan)

Presenter: CHAPMAN, Dean (University of Saskatchewan)

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