A NEW MULTI-WAVE DIFFRACTION ENHANCED IMAGING TECHNIQUE: LAUE DIFFRACTION CASE.
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Diffraction Enhanced Imaging (DEI) conventionally uses an analyser crystal to produce phase-contrast images sensitive only to phase changes (refraction effects) parallel to the diffraction plane (Chapman et al., 1997). With this technique much information regarding the object is lost. Using silicon wafers in Laue geometry it is possible to produce multiple analyser reflections, with each reflection sensitive to a different component of the phase gradient.

Silicon (1,1,1) wafers were used to produce three simultaneous reflections from the (3,3,3) family of planes. This required an X-ray energy of 17.7929 keV. Each (3,3,3) reflection is found at a 120 degree angle to the next, with respect to the transmitted beam. A flat panel detector (C7942, Hamamatsu Photonics) was used to capture all reflected beams alongside the transmitted beam. The experiment was performed at beamline BL20B2 with experimental hatch 3 used to position samples, analyser and detector. Hutch 3 is located in the medical imaging centre.

Together with the three (3,3,3) reflections, two (5,1,1) reflections were simultaneously recorded on the flat panel detector. The picture below is the image of a 3 mm Perspex block with four 1 mm holes drilled at various angles. The reflected images show the variations in contrast along different axes, providing the proof of principle. All the images can be combined to yield separate absorption and refraction images. Only the (3,3,3) reflection shows an image size comparable to the transmitted beam as the wafer was not ideally flat. With a more appropriate crystal this technique provides a method of acquiring phase-contrast movies without losing information about the object; a major advantage for imaging live biological materials.