The Convergent Beam Method for X-Ray and Neutron Microdiffraction Applications

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In 1977 Wyckoff and Agard published a theoretical paper that indicated the possibility to carry out protein crystallography studies with an x-ray beam convergent in one plane. This was intended to show that an x-ray beam incident on a small protein sample from a line focus x-ray source could be used for such measurements. This observation did not attract widespread attention or application. Following development of practical x-ray focusing optics during the early 90's, beginning in 1996, the use of highly convergent static x-ray beams (as differentiated from slightly convergent beams frequently used with the oscillation method) began to be investigated for diffraction applications. Computational and theoretical bases for such applications followed soon after. These studies concentrated on protein diffraction applications. Extension of the convergent beam method (CBM) to neutron diffraction has also been demonstrated with reported beam intensity gains as high as 100 for single crystal and 500 for powder diffraction from small (~100 µm) samples with highly convergent neutron beams. Systematic studies of convergent beam protein x-ray diffraction and neutron diffraction both for structural and strain distribution studies are underway. This paper will summarize experimental and theoretical results and discuss the potential importance of the CBM for laboratory and possible in situ microbeam diffraction applications.

Keywords: convergent-beam diffraction, protein convergentbeam crystallography, neutron convergent-beam crystallography