New X-ray Scattering Methods for Nanostructures

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Despite the advancement of electron microscopy (TEM) and scanning tunneling microscopy (STM), a general method of getting atomic images for nano- and bio- structures is still lacking. This is because TEM mainly works for a thin sample under high vacuum and damages beam sensitive materials such as organic species, while STM probes only the surface and is less accurate. Employing high resolution X-ray diffraction, several new methods were proposed to obtain structural information at atomic level.

One method uses a single X-ray beam to construct a hologram without the reference beam [1]. It is deterministic and needs no phasing. It also amplifies the weak signal, and eliminates the forward scattering (k=0), thus having big advantages over the existing technologies.

Another method recovers phases from Bragg peak profiles [2]. It is based on the fact that at off-Bragg positions, the mismatch of the reciprocal vector and the scattering vector produces an intensity asymmetry, which is connected to the relative phases of the structural factors.

Finally, under special circumstances, the non-crystalline nature can be examined by the intensity, position and profile of the Bragg reflections [3], which were used to solve the long standing problem of the exact structure of multiwall carbon nanotubes (MWCNT) [4].

References:

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