Use of coherent X-ray diffraction to image surfaces and interfaces

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X-ray diffraction with a coherent beam will preserve the crystallographic phase of the entire object under illumination. In the case of surfaces the reflected beam at each location acquires a phase representing the height there. The interference between the contributions from different locations results in intensity modulations in the diffraction pattern which can be recorded with a high-resolution detector. In principle, this can be inverted to an image of the surface or interface morphology. An analogous situation exists for the antiphase domains in a binary alloy, where the phase of the diffracted beam represents the local order parameter. We have recorded such diffraction patterns using the (100) and (110) diffraction peaks of a crystalline thin film of Cu3Au with (111) orientation. Undulator radiation of 8.5keV from the Advanced Photon Source was required for the coherence. The texture in this sample is due to antiphase domains which are around 1000A in size. The diffraction patterns have been inverted using the Gerchberg- Saxton and hybrid-input-output algorithms to produce images of the domain texture.