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Direct imaging antiferromagnetic domain patterns using magnetic x-ray diffraction phase contrast

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We discuss a recently demonstrated domain imaging technique based on the localization of domain boundaries by resonant magnetic diffraction of coherent x rays. Contrast arises from reduction of the scattered intensity at the domain boundaries due to destructive interference effects. We demonstrate this approach by imaging antiphase domains in representative collinear antiferromagnets. Real-space imaging of the temperature-dependent development and evolution of such domains is demonstrated for the first time. Unlike the conventional coherent diffraction imaging, this technique does not involve any numerical algorithms. It is fast, sensitive, produces large-scale images in a single-exposure measurement, and is applicable to a variety of magnetic domain types. It should find various applications in the physics of antiferromagnetism, including phase transitions, topological domain textures, antiferromagnetic spintronics, topological materials, studies of nonlocal transport, and device physics.