Ultrafast domain dynamics in Sr2IrO4

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Abstract

I will present the results of recent XFEL experiments on the dynamics of antiferromagnetic domains in Sr2IrO4 which are relevant to electron transport and could motivate future theoretical investigations. Bragg Coherent Diffraction Imaging (BCDI) methods have been used to quantify domains and domain walls in the long-range antiferromagnetic (AFM) state of Sr2IrO4 at low temperature. We can visualize how Sr2IrO4 organizes itself in space and time following its electronic demagnetization driven by an ultrafast laser. We found by ultrafast pump-probe resonant coherent X-ray imaging that domains shrink and regrow in the same location every time. Ultrafast magnetic BCDI experiment were performed at the MID instrument of the European X-ray Free Electron Laser (XFEL) facility. The 106 magnetic reflection of a high-quality single crystal sample of Sr2IrO4 was aligned at 100 K and 11.215 keV, just below the Ir L3 absorption edge, using XFEL self-seeding. Real space images, obtained by inversion of the BCDI diffraction patterns, revealed an array of antiphase domains, a few microns in size, which shrank and grew again in response to a 50 fs laser pulse of 15 mJ/cm2. The speed of motion of the magnetic domain walls was found to be in the range of 3x10^6 m/s, relevant to electron transport.