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Probe and control of coherent lattice motions using femtosecond electron diffraction SHOUHUA NIE, HYUK PARK, XUAN WANG, RICK CLINITE, JIM CAO — Coherent phonon control provides a mean to directly control the lattice dynamics and drive the lattice into novel and non-equilibrium states, which are not accessible by the conventional thermal excitations. Previously, this technique has been mostly used with fs optical spectroscopy as an indirect probe of lattice motions. Recent advances in time-resolved X-ray diffraction have provided a capability of more direct measurement by monitoring the corresponding diffraction intensity change, albeit with the limitation of probing only single Bragg peak. Here we report a direct and real-time probe and control of coherent lattice motions with fs electron diffraction. By recording a complete diffraction pattern, the lattice motions can be directly measured with sub milli-ångström spatial resolution on the fs time scale, which make it possible to determine the lattice vibrational modes without any ambiguity. In addition, by using a sequence of excitation pulses, we were able to control both the amplitude and phase of coherent lattice motions.

Shouhua Nie

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