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Ultrafast Extreme Ultraviolet Holography: Dynamic Measurement of Surface Deformation MARK SIEMENS, OREN COHEN, QING LI, MARGARET MURNANE, HENRY KAPTEYN, University of Colorado, JILA, RA'ANAN TOBEY, University of Oxford, KEITH NELSON, Massachusetts Institute of Technology — We demonstrate femtosecond time-resolved dynamic holography using coherent extreme ultraviolet (EUV) light generated by high harmonic upconversion of a femtosecond laser. We use a novel excitation geometry in which a pump laser excites a narrow line on the sample, and a much larger EUV beam probes the perturbed sample. The unperturbed portion of the sample reflects the EUV beam to serve as the reference beam, while the pumped region diffracts the EUV probe to from the object beam. The interference of the two beams forms a dynamic hologram that changes as the surface relaxes. By varying the pump-probe delay time, we observe laser-induced surface displacement and subsequent acoustic oscillations in thin metal films. EUV probing in this manner has sub-picometer sensitivity to vertical surface deformation, and is largely free of ambiguities associated with electronic and photoelastic effects that complicate other photoacoustic schemes. In the future, we will extend phase-sensitive detection to study other transient dynamics, such as thermal transport in nanostructures.

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