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Mapping Electric Fields in Space and Time with Solid-State High Harmonic Generation M. TAUCER, National Research Council Canada and University of Ottawa, Ottawa, Canada, G. VAMPA , Stanford PULSE Institute, SLAC National Accelerator Laboratory, Menlo Park, USA, T. J. HAMMOND, X. DING, National Research Council Canada and University of Ottawa, Ottawa, Canada, X. ROPAGNOL, T. OZAKI, S. DELPRAT, M. CHAKER, N. THIRE, INRS-EMT, Varennes, Canada, B. SCHMIDT, few-cycle Inc., Montreal, Canada, F. LEGARE, INRS-EMT, Varennes, Canada, D. KLUG, National Research Council Canada, Ottawa, Canada, A. NAUMOV, D. VILLENEUVE, A. STAUDTE, P. CORKUM, National Research Council Canada and University of Ottawa, Ottawa, Canada — Even-order harmonics, which are normally forbidden in centrosymmetric media, can be produced in the presence of a symmetry-breaking electric field. This principle has long been known in the perturbative regime, where electric fields can enable second harmonic generation.We demonstrate the extension of this technique to the non-perturbative regime, showing that high-order harmonics allow us to measure electric fields in solid matter. We illuminate Si and ZnO samples with ultrafast mid-infrared pulses, with intensity on the order of 1 TW/cm^2. Symmetry-breaking fields are provided by voltage pulses applied to electrodes at the semiconductor surfaces, or, in a second experiment, by a THz transient. The even harmonic emission measures the electric field in time, with sub-picosecond temporal resolution. In addition, we can image even harmonics to reveal the spatial distribution of fields. The technique is a flexible all-optical probe of fields, which can combine high spatial and temporal resolution.

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