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Attosecond time-resolved studies of band-gap excitations in semiconductors KRUPA RAMASESHA, MARTIN SCHULTZE, STEPHEN LEONE, DANIEL NEUMARK, University of California, Berkeley — Attosecond time-resolved spectroscopy is an emerging technique that has proven to be powerful in investigating electron dynamics in atoms, molecules and dielectrics. Attosecond transient absorption spectroscopy is used to follow electron dynamics in semiconductors. In these experiments, a few-cycle visible pulse excites electrons across the band gap of a semiconductor, followed in time by an attosecond extreme ultraviolet pulse to probe changes to the core level transitions, which report on the electronic structure of the material. Using the few-cycle strong field visible pulse to excite the direct band gap of silicon and an attosecond pulse to probe the Si $L_{2,3}$ edge, we have resolved ultrafast carrier generation in the conduction band as well as band gap renormalization. These experiments have revealed transient shifts and broadening to the $L_{2,3}$ edge of Si on a few femtosecond timescale, reflecting an instantaneous response of the electronic structure to ultrafast excitation. The studies will be extended to probe electron dynamics in heteroatom semiconductors such as copper oxide and three-band materials such as tellurium-doped zinc oxide.

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