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Ultrafast resolution of photocurrent generation bottlenecks in stacked van der Waals materials KYLE VOGT, Department of Physics, Oregon State University, Corvallis, OR 97331, USA, SUFEI SHI, Department of Chemical Engineering, Rensselaer Polytechnic Institute, Troy, NY 12180, USA, FENG WANG, Department of Physics, University of California, Berkeley, CA 94720, USA, MATT GRAHAM, Department of Physics, Oregon State University, Corvallis, OR 97331, USA — Combining E-Field dependent ultrafast photocurrent and transient absorption microscopy, we determine the fundamental electron extraction rates that determine photocurrent efficiency in stacked WSe_2 devices. We find that both measurement techniques yield the same rate limited ultrafast time constant of 87 ps, associated with exciton dissociation and electron escape. Using the corresponding the recombination rates, we can calculate the upper bound of IQE in our device to be $\sim$51% which agrees with our directly measured on-chip photoefficiency.

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