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Sub-surface minority carrier lifetime mapping in photovoltaic materials

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The minority carrier lifetime is considered one of the most critical and variable parameters in photovoltaic materials. However, accurately measuring its value is one of the great challenges in evaluating unconventional semiconductor materials for PV applications. I will describe our two-photon time-resolved photoluminescence decay measurements, which allow us to decouple surface and bulk recombination processes even in unpassivated samples. We demonstrate how the traditional one-photon technique can underestimate the bulk lifetime in a CdTe crystal by 10X and show that two-photon excitation more-accurately measures the bulk lifetime. I will finish by discussing how this technique enables the generation of three-dimensional minority carrier lifetime and charge collection efficiency maps that will be useful in identifying efficiency bottlenecks for new and conventional (e.g. CdTe & CIGS) thin film PV materials.

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