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Ovshinsky Sustainable Energy Fellowship: Excitonics for Transparent Photovoltaics

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Room-temperature excitonic materials offer new opportunities for low-cost photovoltaic (PV) systems and provide prospects for unique solar harvesting science and applications. In the first part of this talk, I will introduce our pioneering work on developing transparent PVs that are creating a new paradigm for seamless solar harvesting around buildings, automobiles, and mobile electronics. These devices are enabled by the manipulation of excitonic semiconductor materials with selective harvesting in the nearinfrared and ultraviolet components of the solar spectrum. I will describe key photophysical properties, outline the thermodynamic and practical limits to these new classes of materials and devices, and briefly discuss their commercial impact for a range of applications. In the second part, I will describe the development of a new series organic salts that allow tunable photoresponse from 900nm to 1600nm, an unprecedented range for smallmolecule semiconductors. These organic salts also enable precise tuning of frontier orbital levels and heterojunction interface gaps through anion alloying that result in voltages near the thermodynamic limit. This design strategy can further enable rapid development of efficient and lowcost multijunction devices (both opaque and transparent) with complimentary response across the solar spectrum.