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Abstact: Photovoltaics Beyond Solar: Powering the Internet of Things and Bio-Implantable Devices

Photovoltaics provide a transformative means of electricity generation through clean and renewable solar energy, where cost has become competitive with other energy sources. While solar photovoltaics have justifiably received tremendous attention over the past several decades, photovoltaic cells that harvest energy in lighting conditions beyond direct sunlight can have a tremendous impact on autonomous systems. Extending far beyond the early days of solar-powered calculators and watches, the combination of photovoltaic cells and low power circuitry can provide a vast array of wirelessly interconnected devices or “internet of things” that can operate perpetually under low flux light conditions such as today’s highly efficient indoor lighting. GaAs-based photovoltaics offer high efficiency for indoor lighting while also maintaining cost feasibility for powering mm-scale systems. In this presentation, the design, underlying physical operation, and optimization of GaAs-based photovoltaics and monolithic arrays will be presented, including application to self-powered systems such as “the world’s smallest computer”. Additionally, photovoltaics utilizing the near infrared transparency window of biological tissue offer a means of efficient wireless power transfer for highly scaled bio-implantable devices that overcomes major obstacles in technologies such as RF and ultrasound. Efficient mm-scale near-infrared energy harvesting will be presented, which may ultimately enable bio-implantable that can be used for applications including cancer treatment and neural interfaces.