Optical nano-antennas harvesting solar energy for a greener future

The sun is the cleanest, most powerful and abundant energy source available in the world. However, current solar photovoltaics (PV) produce roughly 4% of the world's electricity, due to their low efficiency and relatively high costs.

GreEnergy

Most energy sources used today rely on non-renewable resources and contribute to global warming. GreEnergy tackles this challenge and addresses the societal, environmental and industrial needs by prototyping a self-powering system based on optical nano-antennas as cost-effective solar energy harvester.

In GreEnergy, we aim at developing an integrated optical antennas array, which can harness solar energy with very high efficiency (20-40%), at an estimated system cost below €100 per 1 m^2.

The GreEnergy solar energy harvesters might change the energy market dramatically, with potential implications for energy providers (centralised power plant) and solar cell related companies, by providing an alternative to current PV cells.

The IoT market would also benefit from the autonomous and long endurance properties of the GreEnergy devices with various possible applications from optical telecommunication to optical sensing. Future applications might also include biosensing and biomedical nano-communication.

CHALMERS UNIVERSITY OF TECHNOLOGY · AMO · SCIPROM Science, Management & Communication · IHP · NOGAH Photonics Ltd · Università Politecnica delle Marche · Aalto-yliopisto · Università degli Studi di Udine

The GreEnergy partners represent a well-balanced cluster of enterprises and academic institutions across six different countries.

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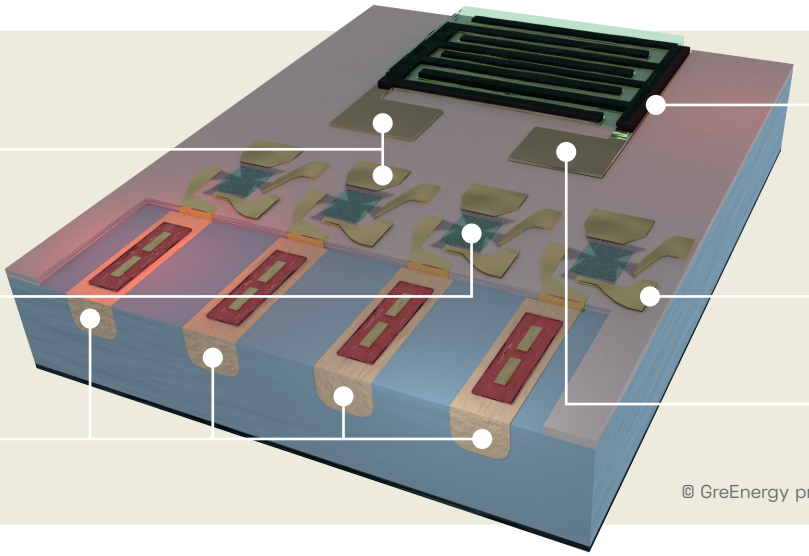
Optical Rectenna

Design and fabrication of the optical wideband antenna coupled to a nano-rectifier. Graphene-based geometric diodes and metal-insulator-metal (MIM) diodes will both be tested to rectify electromagnetic waves at optical frequencies into a direct current, with high conversion efficiency.

Energy Storage for a self-powering system

Modelling and fabrication of the micro-supercapacitor (MSC), charged by the harvested energy from the rectenna, with high capacitance and very long cycle life. Appropriate interface circuitry will be designed for connecting storage and harvester.



Circuitry

Design and simulation of the I/O circuitry between rectenna and energy storage unit, to stabilise the diode output.

System Integration & Demonstration

Development of the process for on-chip integration of rectenna with energy storage device. Design and fabrication of the prototype of the integrated system. Simulation of the integrated components, to demonstrate successful charging of the MSC by the rectenna with 20-40% efficiency at the system level. Benchmark the technology for future development and commercialisation.