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High Power Laser Powering Radial Thermoelectric Devices: an innovative Wireless Energy Transfer System

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Nowadays, mobility, convenience, and safety of electronic devices are concerns present in our day-to-day life. Considering that everyday life small devices have a low-power consumption (mW or nW), the search for simple alternative energy sources is rapidly increasing. Energy Harvesting (EH) technology emerges as an excellent solution for this type of application, replacing batteries and providing a long-term power supply [1].
Herein, we propose a new Wireless Energy Transfer (WET) system for long distances, where the most common solutions based on magnetic induction are less efficient. This system combines the concept of WET with EH technology, i.e., thermoelectric generators (TEG) charged by a high-power laser beam. The resulting heat caused by the focused laser beam works as the heat source for the TE device, thus creating a temperature gradient. With sustainability and cost-effectiveness in mind, screen-printing, a low-cost and scalable method, was used to fabricate the TE devices, printed in a flexible substrate, by combining TE particles and a polymeric binder to form the printable ink. The studied inks were formulated using Bi-Te particles (<50 μm) as the functional TE material and Polyvinyl Alcohol (PVA) as the binder, as produced in a previous study [2].
The proposed device presents a radial configuration where the TE stripes are connected in series, and the temperature gradient is applied from the centre (where the laser beam is focused) to the outside. The fabricated devices were characterized at low pressure (˜10^{-6} Torr), reaching a maximum output voltage of 85 mV, with an applied temperature gradient of approximately 80 K. A maximum power density of ˜ 1.1 μWcm^{-2} was attained.
This promising technology can generate a constant voltage for several hours without additional heat dissipation, besides having a rapid response to the incidence of the laser beam. Therefore, it can be advantageous for energy generation in remote places where the replacement of batteries is an inconvenience, and the wireless charging inductive systems fall short due to the long distances.

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