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Enhancing thermoelectric properties of conductive polymers using Zr-metal-organic frameworks composite materials

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Thermoelectric generators (TEGs) that can directly convert waste heat into electricity, have many advantages over traditional electricity generators because they are considered as environment friendly, have no moving parts, have high scalability, which means they can be applied to heat source of any size. The thermoelectric performance of a material is evaluated by the dimentionless figure of merit ZT = α 2 σT/k, where α is the Seebeck coefficient, T is the absolute temperature, σ is the electrical conductivity, and k is the thermal conductivity. So decreasing the thermal conductivity (k) of the material is a critical issue to improve its performance. TEGs are possible devices using for power generation for implantable devices such as Glucose monitor, Drug pump, Cochlear implant and many other devices. The power requirements for most of the implantable devices ranging from 30μW–2mW, which can be provided by TEGs from the human's body heat.

Polypyrrole, a conducting polymer, attracts most of the attention due to its ease of preparation, high thermal and environmental stability and biocompatibility, which make it a good candidate for implantable TEGs. Most of metal-organic frameworks (MOFs) are considered as insulator with low thermal conductivity and high stability and biocompatibility. MOFs are intrinsically porous that in turn can scatter phonons through the material.

Conclusion and significance, Controlling the polymerization of polypyrrole (Ppy) in presence of Zr-based metal organic-framework (Zr-MOFs) using sodium dodecyl sulphonate (SDS) as a dopant, leads to the formation of a new class of thermoelectric materials based on conducting polymer and highly porous MOFs with enhanced properties for energy production applications. The polymerization of polypyrrole in the Zr-Fumerate pores leads to the formation of homogenously coated MOF-spheres with high crystallinity and a high degree of improvement in many electrical properties such as conductivity and carrier mobility. ows the importance of this work and its alignment with several sustainable development goals.

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