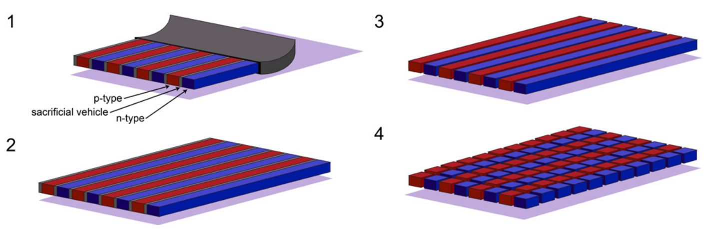
LATEG

LARGE-AREA THERMOELECTRIC GENERATORS

PARC has a breakthrough approach to manufacture high-performance, low-cost thermoelectric (TE) devices that will enable the capture of low-temperature waste heat, a large and difficult-to-harness energy resource.

Low-Grade Waste-Heat Capture through Printed Large-Area Thermoelectric Modules

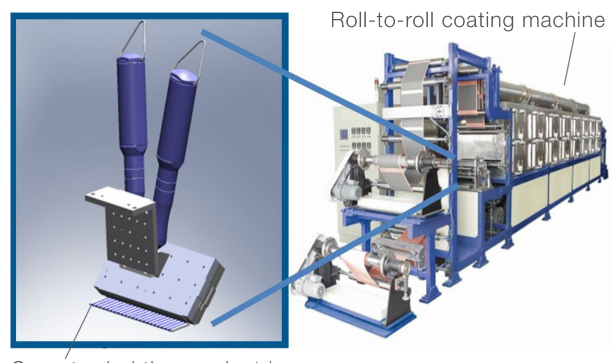
Waste heat at temperatures below 230°C represents approximately 60% of lost heat or 900 TBtu/yr in the United States. Capturing this energy from process steam condensate, industrial process water, and other sources would directly offset energy production requirements. The two leading technologies for low-temperature waste-heat harvesting, Organic Rankine Cycle (ORC) and Kalina cycle engines, cost above $1,100/kW. The proposed system, based on large-area thermoelectric generators (LATEGs), would be able to generate electricity from temperature sources as low as 100°C - 250°C at an installed cost under $600/kW.



In the LATEG system, n- and p-type thermoelectric pastes are (1) co-extruded in (2) stripes separated by a sacrificial material. (3) The pastes are sintered and the sacrificial material burns off. (4) For improved performance, the stripes can be diced orthogonally to form individual legs. Legs are series electrically connected through interconnect patterning.

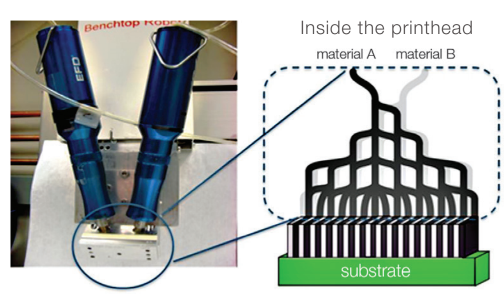
Direct energy conversion using TE technology avoids the exergy lost and power consumed, as well as the additional capital and maintenance costs of transferring heat to a remote electricity generator. However, the current method of manufacturing TE generators based on the assembly of individual legs on ceramic plates is not well suited to producing cost-effective, large-area systems at scale.

PARC's co-extrusion printing technology offers the ability to print fine interdigitated lines and striped structures with micrometer-scale control of geometry based on co-extrusion of alternating dissimilar material pastes. This allows for optimization of microscale device structures while maintaining the nanoscale properties of the materials through a process that is scalable to low cost. This technology allows full module fabrication through direct deposition of both p- and n-type TE materials, as well as patterned electrical interconnects, on a substrate, in a roll-to-roll-compatible process.



Roll-to-roll manufacturing of thermoelectric modules

The co-extrusion process is well-suited to deposition of nanobulk thermoelectric materials. PARC's partner, Novus Energy Technologies, has benchmark nanomaterials that have been used in demonstrations of ZT >>1 in both p- and n-type polarities, and have achieved a power generation density of >3.5 W/cm^2 in prototype devices.



Co-extrusion print-head

Contact PARC to learn more: **engage@parc.com**

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