

## Advanced Nano-phase Materials Promise to Revolutionize Solid State Power Generation, Peltier Heating/Cooling

### **Properties**

- High electrical conductivity
- Significantly reduced thermal conductivity
- Potential for highest Figure of Merit from any thermoelectric material (far superior to state-of-the-art material)

### **Benefits of Fabrication Method**

- Omni-directional thermoelectric devices
- Can provide a leg length (length over which a heat gradient acts) as long as desired
- Nano-components will self-assemble
- Makes possible a practical, economically viable way to cool micro-electronics

Eltron has developed nano-phase materials that could revolutionize solid state thermal power generators and Peltier heater/coolers.

### **Figure of Merit**

Three characteristics affect the Figure of Merit for thermoelectric materials.

- ♦ Eltron's process for self-assembly of zero dimensional nanoparticles has proven to be very effective at inhibiting heat propagation. This is done by lowering the thermal conductivity by over two orders of magnitude compared to what can be achieved by other methods (in the same materials).
- ♦ Eltron also anticipates achieving a much higher Seebeck Coefficient through a novel composition technique. We have demonstrated this in similar materials and are now working to apply it to our favored materials for these applications.
- ♦ Electrical conductivity is the third property used to determine the Figure of Merit and Eltron's materials have tested very high.

Given these three characteristics, it is anticipated that Eltron's materials will yield the highest reported Figure of Merit.

### **Economics**

Eltron has also kept economics in mind during this development effort. The self-assembling technique, when used to prepare films, will provide for large-scale fabrication methods, resulting in low production costs and providing Eltron and their business partner(s) with a competitive advantage.

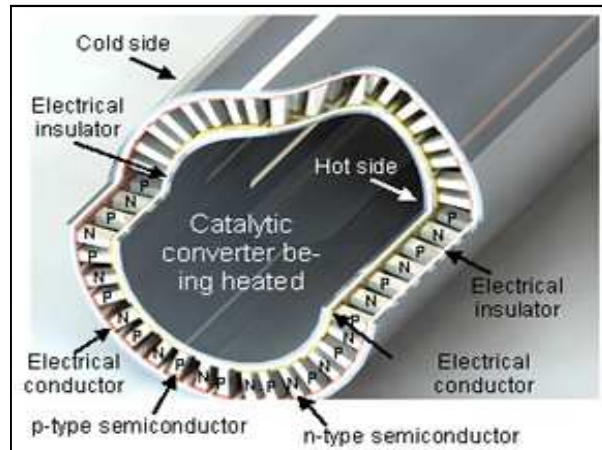
### **Applications**

Applications for this technology are quite varied and include solid state power generators and cooling devices for the electronics industry. The efficiencies and economic advantages of devices using these materials would be extremely high.

Figure 1 shows one of the many ways these inexpensive and easily fabricated thermoelectric materials could be used. The thermoelectric device covers the exhaust system of a car, where it acts to quickly heat the catalytic converter to operating temperature after the vehicle is started. Ninety percent of pollutants generated by today's cars are created before catalytic converters are warm enough to begin working. After heating the exhaust system, the thermoelectric device will switch modes, generating electricity by using waste heat from the exhaust that can be used to power auxiliary systems or charge the car's batteries and capacitors.

### Stage of Development

The development of these materials is currently underway at Eltron. Proof of concept of our approach has been achieved and we are working to produce a prototype device for testing.



**Figure 1.** Schematic showing structure of a thermoelectric device that will act as both a Peltier heater and thermoelectric power generator. As a temperature regulator, it is basically a circuit made up of many p-n junctions on the hot side and many n-p junctions on the cool side. Reversing the current reverses the sides that get hot and cold. As a power generator, the temperature difference between the two sides creates a current that can be stored using a battery or capacitor. This application is not possible with current thermoelectric materials but would be enabled by Eltron's technology.

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### Contact Us

To discuss the possibility of entering into a business relationship with Eltron, contact the Business Development Group at [business@eltronresearch.com](mailto:business@eltronresearch.com).



### Eltron Research & Development Inc.

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