New knowledge about thermoelectric materials could give better energy efficiency

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Thermoelectric materials can be assembled into units, which can transform the thermal difference to electrical energy or vice versa – electrical current to cooling. An effective utilization requires however that the material supplies a high voltage and has good electrical, but low thermal conductivity.

- The new knowledge explains exactly why some thermoelectric materials can have the desired low thermal conductivity without degrading the electrical properties. This can be crucial for the conversion of wasted heat, for example, from vehicle exhaust emissions. Leading car manufacturers are now working to develop this possibility and the first models are close to production. The technology is expected to give the cars considerably improved fuel economy, explains Bo B. Iversen, Professor at iNANO at the University of Århus. The new knowledge can also contribute to the development of new cooling methods, so that one avoids the most common, but very environmentally damaging greenhouse gas (R-134a). All of which is a gain for the environment.

In the *Nature Materials* article the researchers have studied one of the most promising thermoelectric materials in the group of clathrates, which create crystals full of 'nano-cages'.

"By placing a heavy atom in each nano-cage, we can reduce the crystals' ability to conduct heat. Until now we thought that it was the heavy atoms random movements in the cages that were the cause of the poor thermal conductivity, but this has been shown to not be true," explains Asger B.

Abrahamsen, senior scientist at Risø-DTU.

The researchers have used the technique of neutron scattering, which gives them opportunity to look into the material and see the atoms' movements.

"Our data shows that, it is rather the atoms' shared pattern of movement that determines the properties of these thermoelectric materials. A discovery that will be significant for the design of new materials that utilize energy even better," explains Kim Lefmann, associate professor at the Nano-Science Center, the Niels Bohr Institute at the University of Copenhagen.

Source: University of Copenhagen