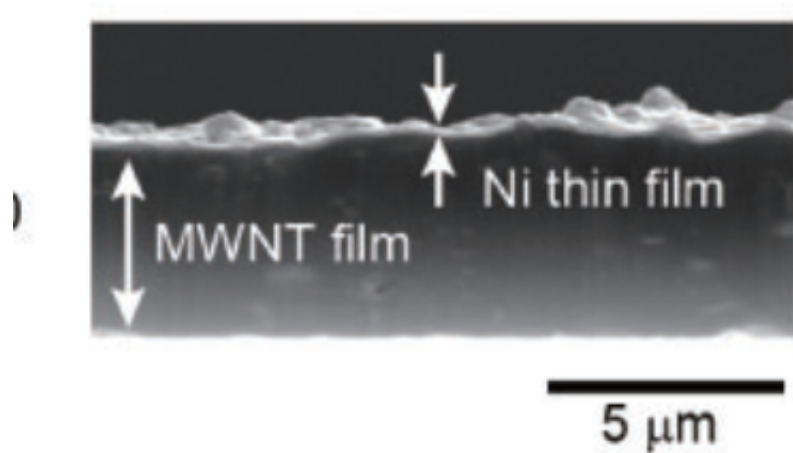


Carbon-nanotube strips harness waste heat

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Cross-sectional scanning electron microscope image of the Ni/MWNT freestanding film.

Where work is done there is waste heat, but research is making progress toward ways of harnessing heat so that this energy is not wasted. Devices for converting heat into mechanical energy and then into electrical energy have attracted particular interest because they produce higher voltages that can outperform Seebeck thermoelectric devices, which convert heat directly into electrical energy. However, thermal-to-mechanical energy-conversion devices have so far been large, heavy and required bulky heat baths and operating temperatures significantly above room temperature. Now, Takashi Ikuno, Tatsuo Fukano, Kazuo Higuchi and Yasuhiko Takeda have developed a simple 'bimorph' strip just

millimetres in length, which converts heat into mechanical energy at temperatures below 100°C, and under a temperature difference of as little as 5°C.

The bimorph strip is a freestanding film (FSF) with a composite of multiwalled carbon nanotubes (MWNT) on one side and nickel on the other. The nickel expands much more readily than the MWNT composite, and this causes the strip to bend when in contact with a hot surface. When the strip bends, the nickel moves away from the hot surface, where it rapidly cools due to the strip's low [heat](#) capacity. On cooling, the strip stretches toward the hot plate where it is heated again, and so it continuously bends and stretches, generating [mechanical energy](#).

The bimorph strip's low mass and small size are key to its high heat sensitivity, and also make it ideal for integration into microdevices. The heat sensitivity may be improved further by aligning the carbon nanotubes in the composite layer. The researchers conclude, "We believe that the MWNT-FSFs developed in this study could be one of the building blocks for energy conversion nanodevices."

More information: Takashi Ikuno et al. Bimorph micro heat engines based on carbon nanotube freestanding films, *Applied Physics Express* (2015). [DOI: 10.7567/APEX.8.115101](https://doi.org/10.7567/APEX.8.115101)

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