美国物理学联合会新闻网站专题报道中国矿大教师研究成果

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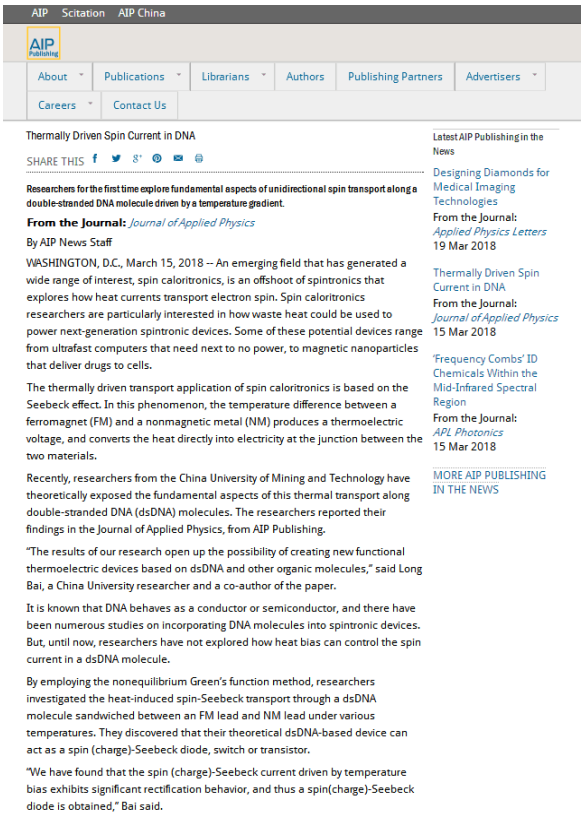
3月15日，美国物理学联合会（AIP）新闻网站以*Thermally Driven Spin Current in DNA*为题，对中国矿业大学能源、材料与物理学部物理学院白龙老师等人的研究进展进行了专题报道。此前，3月7日， AIP旗下的著名期刊Journal of Applied Physics以Featured Article（特色论文）的形式发表了白龙老师等人的最新研究成果——“手性DNA分子的自旋Seebeck效应研究”。

在此项研究成果中，白龙等人创新性地研究了手性DNA分子的热电效应，发现由于手性DNA分子存在的自旋选择性效应，导致这种分子器件的自旋（电荷）流呈现出整流效应，基于这种特征，人们可以用来设计自旋（电荷）二极管、自旋（电荷）开关和自旋（电荷）晶体管。该研究结果对于开发手性有机分子的自旋电子器件具有重要价值。

据悉，AIP期刊编辑通常会在众多发表的文章中选出最有价值的论文以特色论文的形式刊发，用以迅速传播新研究结果和提高论文的影响力。同时AIP杂志会为被遴选的特色论文以专题的形式进行新闻发布。



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Thermally Driven Spin Current in DNA

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Researchers for the first time explore fundamental aspects of unidirectional spin transport along a double-stranded DNA molecule driven by a temperature gradient.

From the Journal: *Journal of Applied Physics*

By AIP News Staff

WASHINGTON, D.C., March 15, 2018 -- An emerging field that has generated a wide range of interest, spin caloritronics, is an offshoot of spintronics that explores how heat currents transport electron spin. Spin caloritronics researchers are particularly interested in how waste heat could be used to power next-generation spintronic devices. Some of these potential devices range from ultrafast computers that need next to no power, to magnetic nanoparticles that deliver drugs to cells.

The thermally driven transport application of spin caloritronics is based on the Seebeck effect. In this phenomenon, the temperature difference between a ferromagnet (FM) and a nonmagnetic metal (NM) produces a thermoelectric voltage, and converts the heat directly into electricity at the junction between the two materials.

Recently, researchers from the China University of Mining and Technology have theoretically exposed the fundamental aspects of this thermal transport along double-stranded DNA (dsDNA) molecules. The researchers reported their findings in the Journal of Applied Physics, from AIP Publishing.

"The results of our research open up the possibility of creating new functional thermoelectric devices based on dsDNA and other organic molecules," said Long Bai, a China University researcher and a co-author of the paper.

It is known that DNA behaves as a conductor or semiconductor, and there have been numerous studies on incorporating DNA molecules into spintronic devices. But, until now, researchers have not explored how heat bias can control the spin current in a dsDNA molecule.

By employing the nonequilibrium Green's function method, researchers investigated the heat-induced spin-Seebeck transport through a dsDNA molecule sandwiched between an FM lead and NM lead under various temperatures. They discovered that their theoretical dsDNA-based device can act as a spin (charge)-Seebeck diode, switch or transistor.

"We have found that the spin (charge)-Seebeck current driven by temperature bias exhibits significant rectification behavior, and thus a spin(charge)-Seebeck diode is obtained," Bai said.

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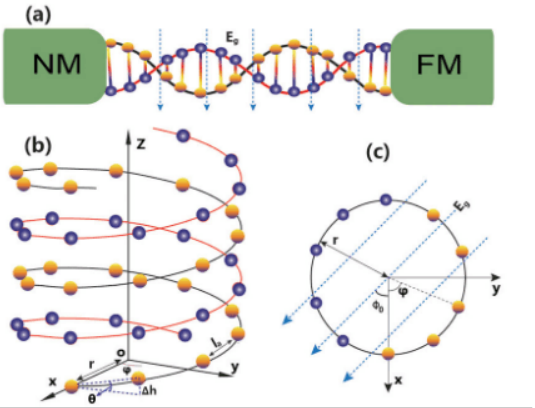
"However, what is notable," Bai said, "is that pure spin current with zero charge current can be achieved in terms of the gate voltage, which represents the perfect spin-Seebeck effect."



(a) Geometry of the dsDNA sandwiched between a nonmagnetic metal (NM) and a ferromagnet (FM) one. (b) Schematic illustration of right-handed dsDNA. (c) Projection of the bottom five base pairs and the electric field into the x-y plane.
CREDIT: Long Bai

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