

SOUND WAVES CAN BE USED IN REDUCING ENERGY CONSUMPTION IN NEXT GENERATION COMPUTING

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Researchers have spotted a new mechanism to generate and control spin currents using sound waves which can reduce energy consumption, have potential applications in quantum computing, and contribute to next-generation communication technologies.

In modern technology, there is a growing demand for faster, smaller, and more energy-efficient devices. Traditional electronics rely on the movement of electric charge, which leads to heat generation and energy loss. To overcome these limitations, researchers are exploring alternative ways of transmitting information. One promising direction is spintronics, where information is carried by a spin instead of electric charge. In this context, magnons, which are the waves of magnetic disturbances inside materials, are emerging as potential carriers of information. They are particularly attractive because they can operate with much lower energy loss compared to electrons.

Researchers from Institute of Nano Science and Technology (INST), Mohali, an autonomous institute of the Department of Science and Technology (DST) have introduced a new mechanism to generate and control magnon-based spin currents (spin wave excitations) using surface acoustic waves (SAWs).

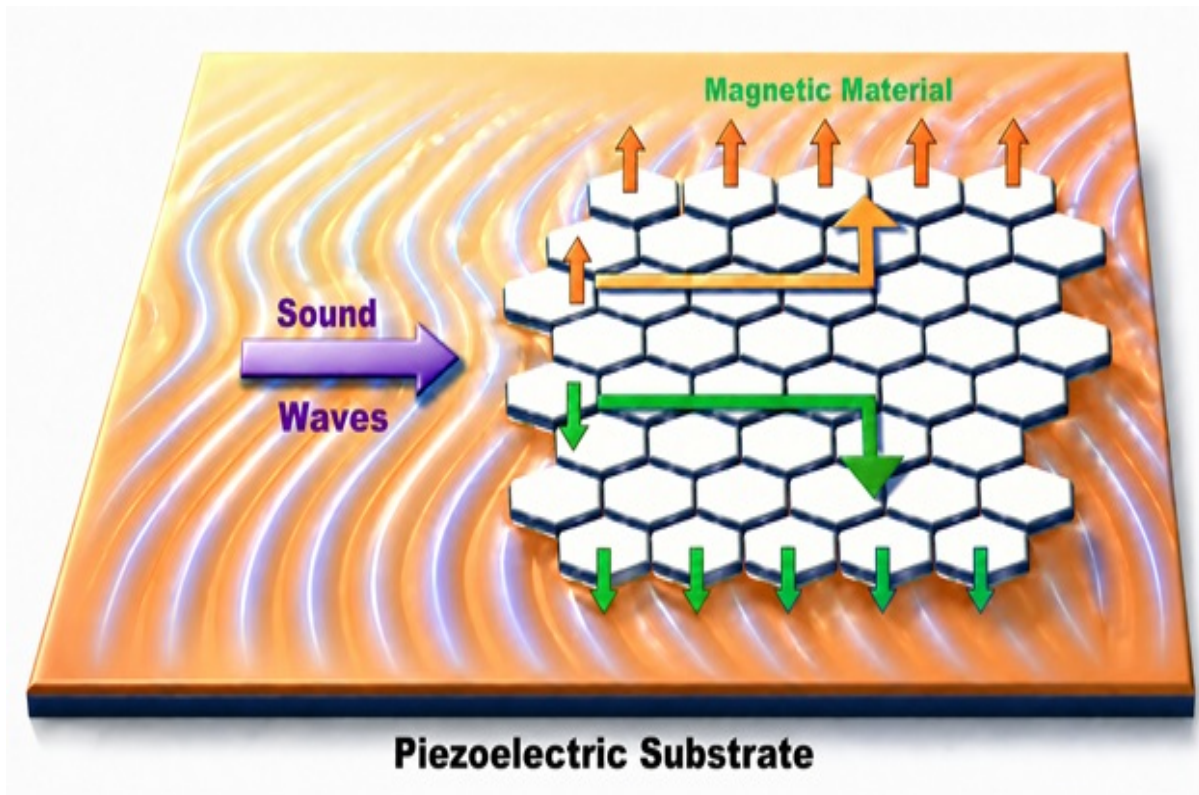


Fig: Schematic diagram of the Sound Waves induced magnon spin current in a graphene-like magnetic material (technically speaking, antiferromagnet material) placed over a piezoelectric substrate. Piezoelectric materials are materials which generate electricity in response to the applied external

Mr. Shivam Sharma, a PhD scholar and his supervisor, Prof. Abir De Sarkar, identified a gap in earlier studies that showed that surface sound waves can influence electron dynamics and that magnon dynamics can be governed by the quantum geometric quantities and developed a new theoretical approach to address the gap.

They developed an analytical model from scratch, that considers a two-dimensional ultrathin material with a graphene-like structure that is magnetic. The material is deposited over the piezoelectric substrate. Using the model, they studied the effect of surface sound waves on magnon transport.

They found that when SAWs travel through a material, they create tiny distortions, which behave like effective forces (called pseudogauge fields) that influence the motion of magnons thereby creating a new way to generate spin currents using surface sound waves in two-dimensional magnets.

This approach published in the Journal Phys. Rev B opens up new possibilities for low-power and highly efficient technologies.

With applications in low-power information processing, strain-engineered devices (where mechanical deformation controls electronic or magnetic behavior) the work is especially relevant for next-generation computing, where reducing energy consumption is a critical goal.

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