Research team develops new compact and energy-efficient nanoscale microwave oscillators

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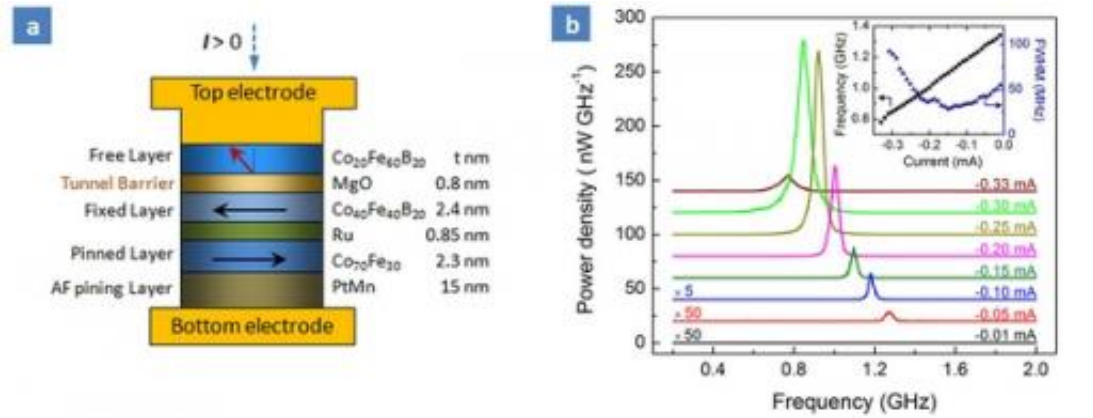

Credit: SINANO

By using improved magnetic materials, based on the control of interface properties of ultra-thin magnetic films, researchers from the Suzhou Institute of Nano-tech and Nano-bionics, Chinese Academy of Sciences (SINANO), the University of California at Los Angeles(UCLA), and the University of Messinahave made major experimental improvements to develop a more compact, more energy-efficient generation of a mobile communication device known as spin transfer nano-oscillator (STNO). STNOs use the spin of electrons to create steady microwave oscillations needed for various applications in mobile communications, unlike current silicon-based oscillators which use their charge. The SINANO

team's improved oscillator has great potential to be used in future portable electronic devices and wireless modules, systems on a chip, and for power-efficient local clock signal generation in digital systems.

The STNOs are composed of two distinct magnetic layers. One layer has a fixed magnetic polar direction, while the other layer's magnetic direction can be manipulated to gyrate by passing an electric current through it. This allows the structure to produce very precise oscillating microwaves. The STNO's key advantage over existing technologies is that it can combine large tunability and low energy with nanoscale size, as well as broad working temperature ranges.

Yet while STNOs are potentially superior in many respects to existing microwave oscillator technologies, their microwave signals mainly rely on both large drive currents and the application of external magnetic fields, which hinders the implementation of STNOs for practical applications in terms of power dissipation and size.

By using magnetic layers with perpendicular magnetic anisotropy– similar to those used in spin-transfer torque memory – the SINANO team demonstrated large microwave signals at ultralow current densities (