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Title: New Approaches for Spin Perception Regulation and Sensing

Abstract: The conventional techniques for regulating electron spin are spin-orbit torque (SOT) and spin-transfer torque (STT), which realize the regulation of electron spin flip through the interaction of the injected current with the magnetic moment of the magnetic metal layer. However, the critical current density required is excessively high ($10^{11} - 10^{12} \text{ A/m}^2$), giving rise to common problems such as thermal dissipation effects and performance instability. Furthermore, strong light fields (femtosecond lasers, polarized lasers) enable the direct flipping of the electron spin orientation by virtue of their ultrafast response and strong coherence, thereby establishing a direct coupling relationship with the magnetic field. Nevertheless, the high prices of the aforementioned light fields further increase the economic cost of micro-nano electronic components. Simultaneously, the instantaneous high energy consumption during laser irradiation can severely affect the magnetic domain walls of adjacent structures in integrated devices and the surrounding quantum spin states. In response to the above problems, the presenter adopted the photovoltaic effect and photovoltaic thin-film technology to excite photogenerated electrons to modulate the electron spin state of ferromagnetic films. No current loop is needed, and spin flip regulation is achieved only through the internal photogenerated current, significantly reducing the critical current density to $1/10^{16}$ of the original, providing theoretical and technical support for the research and development of new low-power photovoltaic spintronic devices.

Biography: Yifan Zhao, male, is an associate professor and doctoral supervisor at the School of Instrumentation Science and Technology, Xi'an Jiaotong University. He received his Ph.D. in Power Engineering and Engineering Thermophysics from Xi'an Jiaotong University in 2017. His research mainly focuses on MEMS micro-nano processing devices and cutting-edge sensing physics, with the aim of breaking through the "bottleneck" technologies in China's sensor field. To date, he has led 8 projects including key research and development programs of the National Science and Technology Major Project, sub-projects of the JW National Science and Technology Major Project, and the National Natural Science Foundation, with a total research budget of over 5 million yuan. He has published 25 SCI papers as the first or corresponding author, among which 14 have an impact factor greater than 10, and 10 are in the top 1 zone of the Chinese Academy of Sciences. He has applied for and been granted 6 Chinese patents and 1 US patent. His research achievements have won the first prize of provincial and ministerial-level science and technology and the 2024 Hot Article Award.