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Auger generation as an intrinsic limit to tunneling field-effect transistor performance

James Teherani

Department of Electrical Engineering, Columbia University

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Abstract: Many in the microelectronics field view tunneling field-effect transistors (TFETs) as society's best hope for achieving a > 10× power reduction for electronic devices; however, despite a decade of considerable worldwide research, experimental TFET results have significantly underperformed simulations and conventional MOSFETs. To explain the discrepancy between TFET experiments and simulations, we investigate the parasitic leakage current due to Auger generation, an intrinsic mechanism that cannot be mitigated with improved material quality or better device processing. We expose the intrinsic link between the Auger and band-to-band tunneling rates, highlighting the difficulty of increasing one without the other. From this link, we show that Auger generation imposes a fundamental limit on ultimate TFET performance.

Bio: James Teherani joined Columbia University as an assistant professor in the Department of Electrical Engineering in 2015. He received his BS in electrical and computer engineering from the University of Texas at Austin in 2008, and his SM and PhD degrees in electrical engineering and computer science from the Massachusetts Institute of Technology in 2010 and 2015. His research interests include the fabrication, characterization, and quantum-mechanical modeling of electronic devices, quantum structures, and emerging materials, especially 2D semiconductors. He was a co-recipient of the 2014 George E. Smith Award for best paper in IEEE Electron Device Letters for his work on record-high hole mobility in strained-Ge MOSFETs.