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Terahertz detection of nanorectifiers SHAHRIR R. KASJOO, CLAUDIO BALOCCO, XIAOFENG F. LU, LINQING Q. ZHANG, YASAMAN ALIMI, School of Electrical and Electronic Engineering, University of Manchester, Manchester M13 9PL, U.K, STEPHAN WINNERL, Institute of Ion Beam Physics and Materials Research, Helholtz-Zentrum Dresden-Rossendorf, Dresden, Germany, AIMIN M. SONG, School of Electrical and Electronic Engineering, University of Manchester, Manchester M13 9PL, U.K — Despite of a broad range of applications in the terahertz (THz) region, there is still a lack of compact, low-cost, solid-state devices that can function at room temperature. Here we report on THz detection by a novel type of unipolar nanodiode, known as self-switching diode (SSD), which is realized by breaking the symmetry of a nanochannel. The SSD has a completely different working principle from conventional diodes since it does not rely on any doping junction or Schottky barrier. Its intrinsically low parasitic capacitance enables electrical rectification at ultrahigh speed. In this report, the SSDs are coupled with standard bow-tie antennas. The THz signals are generated by means of a free-electron laser, at several THz frequencies ranging from 1.3 THz to 2 THz. The THz detection measurements were carried out at room temperature and 20 K. We find that the highest estimated voltage sensitivity achieved at room temperature and 20 K operations are around 390 mV/mW and 46 V/mW, respectively. For detection at room temperature, this is the highest speed reported in nanorectifiers to date. Furthermore, we also observe evidence of THz detection enhancement by localised plasma oscillation before the cut-off frequency as reported in the Monte-Carlo simulations.

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