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Low temperature refrigeration by using thermal-field emission in a coaxial cylindrical diode LIN WU, LAY KEE ANG, Nanyang Technological University, Singapore, WEE SHING KOH, Institute of High Performance Computing, Singapore — We explore new possibilities of refrigeration by using thermal-field emission of electrons in a coaxial cylindrical diode with a nanometer scale inner electrode (or cathode). Our calculation shows that it is possible to provide cooling at temperature down to 200 K if the work function of the cathode is about 1 eV. The limitation on the cooling power density and its temperature range is due to the requirement of low work function of the cathode. By applying an external axial magnetic field, an additional potential barrier near anode is created, and the emission of low energy electrons (below the Fermi energy level) is suppressed to enhance the cooling performance. With this extra filtering process, emitters of arbitrary work functions can be used to provide a cooling capability from 300 K down to 10 K. The optimal conditions to achieve maximum cooling power density are determined both numerically and analytically. The space charge effects of the emitted electrons in the gap are included self-consistently.

Lin Wu
Nanyang Technological University, Singapore

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