THz BACKWARD-WAVE OSCILLATORS FOR PLASMA DIAGNOSTIC IN NUCLEAR FUSION

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The understanding of plasma turbulence in nuclear fusion is related to the availability of powerful THz sources and the possibility to map wider plasma regions. A novel approach to realize compact THz sources to be implemented in the plasma diagnostic at NSTX experiment (Princeton Plasma Physics Laboratory, USA) is reported.

Two novel 0.346 THz Backward-Wave Oscillators (BWOs) have been designed and are presently in the fabrication phase. One BWO is based on the Double Staggered Grating[1] (DSG) that supports a sheet electron beam to provide a high output power; the second BWO is based on the Double Corrugated Waveguide[2] (DCW) that supports a cylindrical electron beam generated by a conventional Pierce gun.

The performance of both the BWOs was computed by Particle-in-cells (PIC) simulations. The DSG-BWO provides about 1W of output power with a beam current of 10 mA and a beam voltage of 16.8 kV.

The DCW-BWO provides 0.74W output power with 10 mA beam current and 13 kV beam voltage.

The DSG and the DCW have been realized by state of the art prototype nano-CNC milling machine (DMG Mori-Seiki) that permits one to achieve performance, in term of cost and surface finishing, unavailable with any other technology. It is the first time that this technique is applied to structures above 0.3 THz.

The high output power of both the BWOs demonstrates the importance of novel approaches in the emerging field of THz vacuum electron devices.

1. Y.-M. Shin, L. R. Barnett, and N. C. Luhmann, "Strongly confined plasmonic wave propagation through an ultrawideband staggered double grating waveguide," *Applied Physics Letters*, vol. 93, no. 22, p. 221504, 2008

2. M. Mineo and C. Paoloni, "Double-Corrugated Rectangular Waveguide Slow-Wave Structure for Terahertz Vacuum Devices," *IEEE Trans. Electron Devices*, vol. 57, no. 11, pp. 3169–3175, Nov. 2010.

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