Characterize THz quantum cascade lasers for local oscillator

J.R. Gao, J.N. Hovenier, P. Khosropanah, A. M. Baryshev, and T.M. Klapwijk

***Abstract*— We will report our studies of THz QCLs at TU Delft/SRON, specifically aiming for the application as local oscillator. The QCLs are metal-metal waveduide QCLs from MIT in USA and surface plasmon QCLs from University de Paris VII/Thales Research and Technology in France.**

***Index Terms*— THz QCL, metal-metal waveguide QCL, surface plasmon QCL, local oscillator, and HEB mixer**

THe region of the electromagnetic spectrum (300 GHz – 10 THz) is crucial for molecular spectroscopy in Earth, planetary and space science. It is the least-explored spectral region, only accessible from space or at high altitudes, because of the strong absorption by the Earth's atmosphere. The Herschel Space Observatory will perform high-resolution spectroscopy covering the frequency range from 480 GHz to 1.9 THz. But the technology from 2 to 6 THz is to-date not ready yet.

In this contribution we will report our studies of THz QCLs at TU Delft/SRON, specifically aiming for the application as local oscillator. The QCLs used are based on a metal-metal waveguide design, operating at frequencies 2.7-2.8 THz, developed by the MIT group (USA). The talk will cover the heterodyne measurement of a 2.8 THz QCL as local oscillator and a superconducting hot electron bolometer as mixer [1]; the phase-locking and spectral linewidth of a two-mode THz QCL [2] and also beam patterns of QCLs with sub-wavelength cavity dimensions briefly [3].

We will report our recent heterodyne measurements using 2.8 THz surface plasmon QCLs, which are developed by University de Paris VII/Thales Research and Technology (France). Because of the improved beam pattern, allowing enough radiation power couple to a mixer, and because of the improved HEB itself, we achieved a double sideband receiver noise temperature (heterodyne sensitivity) of 1050 K at 2.84 THz, which is a record sensitivity at this frequency [4].

We will also make suggestions to the THz QCL community how to improve those devices ready for future space applications.

J.R. Gao is with SRON Netherlands Institute for Space Research, Utrecht/Groningen, The Netherlands and also with Kavli Institute of NanoScience, Delft University of Technology, Delft, The Netherlands. (corresponding author to provide phone: 31-15-2781370; fax: 31-15-2781413; e-mail: J.R.Gao@tnw.tudelft.nl).

J.N. Hovenier and T.M. Klapwijk are with Kavli Institute of NanoScience, Delft University of Technology, Delft, The Netherlands.

P. Khosropanah and, A. M. Baryshev are with SRON Netherlands Institute for Space Research, Utrecht/Groningen, The Netherlands

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