Development of Room-Temperature Schottky Diode Technology for applications in the Tera-Hertz range

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Since 2006 the LERMA-Observatoire de Paris in close collaboration with C2N has made a great progress in the development of the French technology of THz electronic components based on Schottky diodes. By bringing together the unique knowledge and skills of both laboratories, we have developed submillimeter devices at 300GHz, 600GHz and 1.2 THz, with state-of-the-art performances. These devices are selected today for the Submillimetre Wave Instrument (SWI) of the JUICE planetary probe, ESA's first class L mission. The progress made over the last years and our future work on the device miniaturization and increasing working frequency will be discussed in this presentation.

The design of MMIC Schottky based circuits are made by LERMA-Observatoire de Paris. The growth of the especially dedicated MBE epitaxial GaAs structures and the manufacturing of the Schottky-based circuits are performed in the clean room of C2N by LERMA and C2N staff members. We have developed the approach using direct E-beam writing for all fabrication steps, allowing a great flexibility of design, excellent anode definition and perfect alignment between the different lithography steps. An important effort has been made during the last two years in order to improve the fabrication process. A dedicated metal evaporator has been acquired in order to improve the ohmic and Schottky contact. The result of this several-months study was the production of diodes with excellent characteristics and very good homogeneity across the wafer.

In 2015, LERMA demonstrated state-of-the art results on its first MMIC subharmonic mixer at 600GHz. The record low average noise temperature of 750K has been measured at 150K in 520-620 GHz range (with the minimum value of 550K at 560 GHz) [1]. The mixer was used in our laboratory for molecular spectroscopy measurements. It was obtained that our compact 600 GHz room-temperature receiver provides the same order of sensitivity and frequency accuracy as InSb HEB spectrometer [2].

In 2016-2017 we realized our first 1200 GHz receiver for SWI. We obtained a receiver noise temperature two times better than specified for the mission.

Current work focuses on the development of a bias-able 2THz sub-harmonic mixer based on a preliminary design made for ESA R&D study [4].

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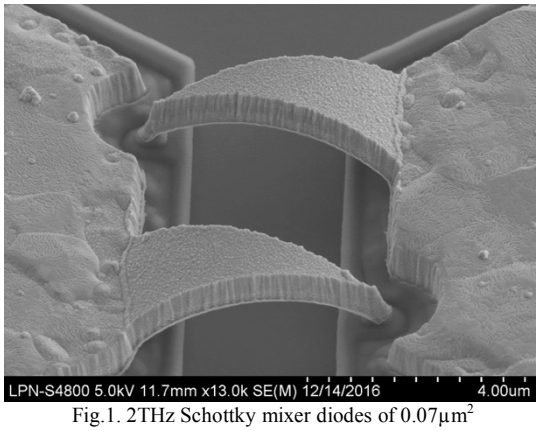

Fig.1. 2THz Schottky mixer diodes of 0.07µm^2

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