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Process Control and Failure Analysis Implementation for THz Schottky-based components

V. Ichizli[a1], M. Rodríguez-Gironés[a], L. Marchand[b], C. Garden[b], O. Cojocari[a], B. Mottet[a], H.L. Hartnagel[a]

[a] *Insitut für Hochfrequenztechnik, TU Darmstadt, Merckstraße 25, 64283 Darmstadt, Germany*
[b] *ESA/ESTEC Keplerlaan 1, 2200 AG Noordwijk, The Netherlands*

Abstract

Schottky diodes and integrated circuits are the most used devices for both frequency mixing and multiplying in THz range. Higher operational frequencies require reduction of the device dimensions. Device dimensions in THz range are often comparable and are even below one micron, which increases the importance of reliability issues of Schottky diodes. Due to the enhanced sophisticated fabrication process, especially in the case of planar devices and integrated circuits, many failure mechanisms of high-frequency semiconductor devices can be directly traced to the failures in the fabrication process. On the other hand, these process failures can often be detected only while testing or even during operation of the final device. This contribution deals with main process failures in the fabrication process of THz Schottky-based components, including their influence on the performance of the final device, and proposes methods for their prevention. Improved performance and device reliability as well as increased process repeatability and reproducibility are demonstrated. © 2002 Elsevier Science Ltd. All rights reserved.

1. Introduction

The interest in THz-electronics is steadily growing due to the prospering fields of its applications, which start with environmental and space applications and extend to medical studies and civil applications like distance sensing in automobile industries and safety issues. Pt/n-GaAs Schottky diodes with cut-off frequencies well above 1 THz (10^{12} Hz) are key active elements for both mixing and multiplying applications in the sub-millimetre wavelength region. Due to the low available power at high frequencies, the requirements on quality and performance are especially demanding [1].

The higher the operational frequency required, the lower device dimensions and the higher the periphery to active device ratio. Although, the latter is positive from the point of view of series resistance reduction, the large periphery to active area ratio sophisticates the device fabrication process significantly.

In such conditions, many failure mechanisms of high-frequency semiconductor devices can be directly traced to the failures in the fabrication process. On the other hand, many failures of the fabrication process can often be detected not earlier than the testing or sometimes even the operation phase of the final device. Therefore, process and quality control, as well as failure analysis, are crucial for THz devices that are already employed in space applications.

To our latest knowledge, there are no publications on systematic process and quality control measures

[1] V. Ichizli has recently joined Radiometer Physics GmbH, Birkenmaarstr. 10, 53340 Meckenheim, Germany.

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