NOVEL RADIO FREQUENCY CONDUCTOR WITH IMPROVED CONDUCTIVITY FOR ULTRA-LOW-POWER WIRELESS APPLICATIONS

Ref-No: TA-PT 1.2610

BACKGROUND

Scientists from the Peter Grünberg Institute of Semiconductor Nanoelectronics (PGI-9) and the Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons, Materials Science and Technology (ER-C-2) at Forschungszentrum Jülich GmbH developed innovative gate preparation solutions to optimize electrode forms for high frequency device operation. The approach leads to an increase in electrode surface area whilst the volume of the conductive material (usually gold) is minimized.

PROBLEM

Conventionally used T-gate structures are essential for radio frequency (RF) transistors to reduce gate resistance. This is one of the most effective methods to improve the device maximum oscillation frequency (fmax). However, further innovative solutions are called for to reduce Skin-effect losses and improve device performance as the structure sizes diminish and the operation frequencies of the devices become even higher.

SOLUTION

The new gate forms developed at Forschungszentrum Jülich GmbH are produced by means of a standardized photolithographic process. The conventionally used lithographical techniques and other technological steps for gate definition are circumvented. For metallization, two materials with metallic conductivity but with different reactivity are employed. Photolithographical methods followed by wet chemical etching are carried out. The approach is scalable and allows for alternative spatial T-gate structures. The innovative technology was applied to form a new double-level-T-gate structure (DLTG) on high electron mobility (HEMT) transistor structures. The total cross-section of the double-level-T-gate contributing to the current transport is about two times higher than for a standard T-gate design (see figure), resulting in halving the gate resistance. The new layout reduces the skin effect related deterioration of the transistor properties. The conductivity is increased at lower material costs and high-

Forschungszentrum Jülich GmbH

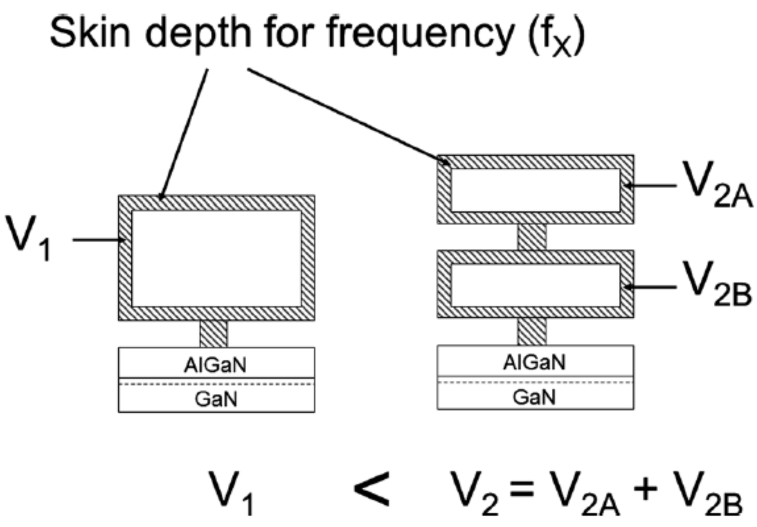
Jörg Bohnemann
+49 2461/61-5711
j.bohnemann@fz-juelich.de
www.fz-juelich.de

DEVELOPMENT STATUS

Proof of concept

CATEGORIES

//Electronics and electrical engineering //Electronic circuits //Electric power transmission //Information and communication technology //Data transmission //Communication engineering frequency characteristics are improved.



SCOPE OF APPLICATION

The technology is suitable for various applications: high frequency components such as high frequency transistors (e.g. HEMTs) for integrated mm-wave circuits for ultra-low-power wireless applications, mm-wave radar for space applications, terahertz bands for indoor wireless, localization studios and gigabyte WiFi networks.

Proof of principle has been shown. Experimental data is available and demonstrates the efficiency of the double-level-T-gate. The shape of the gate needs to be adjusted to different applications. Forschungszentrum Jülich GmbH is interested in commercialization through licensing.

SERVICE

If you have questions about the technology please refer to:

Ernst Ruska-Centre (ER-C) for Microscopy and Spectroscopy with Electrons: Materials Science and Technology (ER-C-2)

Dr. Hilde Hardtdegen

Phone: +49 (0) 2461-61 2360
E-Mail: h.hardtdegen@fz-juelich.de

Dr.-Ing. Martin Mikulics
Phone: +49 (0) 2461-61 5399
E-Mail: m.mikulics@fz-juelich.de

PUBLICATIONS & LINKS

M. Mikulics, H. Hardtdegen, Y.C. Arango, R. Adam, A. Fox, D. Grützmacher, D. Gregušová, S. Stanček, J. Novák, P. Kordoš, Z. Sofer, L. Juul, M. Marso; Reduction of skin effect losses in double-level-T-gate structure, Appl. Phys. Lett. 105 (2014) 232102. https://doi.org/10.1063/1.4903468