Mobility and Carrier Concentration Measurements on nm-Wide Semiconductor Fins

Witthøft, Maria-Louise; Folkersma, S.; Bogdanowicz, J.; Marangoni, Thomas; Mackenzie, David; Vohra, A.; Porret, C.; Loo, R.; Henrichsen, H. H.; Hansen, Ole; Vandervorst, W.; Petersen, Dirch Hjorth

Publication date:
2018

Document Version
Peer reviewed version

Link back to DTU Orbit

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Mobility and Carrier Concentration Measurements on nm-Wide Semiconductors Fins

M.-L. Witthøft\textsuperscript{a,1}, S. Folkersma\textsuperscript{b,c}, J. Bogdanowicz\textsuperscript{b}, T. Marangoni\textsuperscript{a}, D. Mackenzie\textsuperscript{a}, A. Vohra\textsuperscript{b,c}, C. Porret\textsuperscript{b}, R. Loo\textsuperscript{b}, H. H. Henrichsen\textsuperscript{d}, O. Hansen\textsuperscript{a}, W. Vandervorst\textsuperscript{b,c} and D. H. Petersen\textsuperscript{a}.

\textsuperscript{a} Department of Micro- and Nanotechnology, Technical University of Denmark, DTU Nanotech Building 345C, DK-2800 Kgs. Lyngby, Denmark
\textsuperscript{b} IMEC, Kapeldreef 75, B-3001 Leuven, Belgium
\textsuperscript{c} Instituut voor Kern- en Stralingsfysika, KU Leuven, Celestijnenlaan 200D, B-3001 Leuven, Belgium
\textsuperscript{d} CAPRES A/S, Scion-DTU, Building 373, DK-2800 Kgs. Lyngby, Denmark
\textsuperscript{1}email address: mawit@nanotech.dtu.dk

Along the scaling path, the microelectronic industry faces numerous challenges in the growth of group IV semiconductors, such as Ge and GeSn. Especially Ge\textsubscript{1-x}Sn\textsubscript{x} is a promising candidate for source-drain applications and as a stressor in Ge channel devices. However, the material properties of scaled devices can strongly deviate from their bulk counterparts and therefore reliable characterization methods are needed. Measuring the electrical properties of real device structures is particularly important to verify the degree of activation and material quality, both during and after processing. The sheet resistance, sheet carrier density and mobility are well-suited parameters to provide that information. In this study, we demonstrate the capabilities of a micro four-point probe technique in taking advantage of thermoelectric properties for characterization of nm-wide semiconductor fins. This is done by performing a four-point probe measurement with an AC current providing us with the first and second harmonics, which are related to the sample resistance and Seebeck coefficient, respectively. From the Seebeck coefficient, we can determine the charge carrier density directly. Subsequently, the carrier mobility can be extracted using the resistance signal and the Seebeck coefficient combined. We will perform these measurements on fins of B-doped Ge\textsubscript{1-x}Sn\textsubscript{x} on relaxed Ge, which are epitaxially grown in trenches. In this way, the precision of the method can also be evaluated.