Mattias Borg NanoLund: Centre for Nanoscience LTH Profile Area: Nanoscience and Semiconductor Technology LU Profile Area: Light and Materials **Electromagnetics and Nanoelectronics** Type of address: Visiting address. Professorsgatan 1 Lund Sweden Type of address: Postal address. Box 118 221 00 Lund Sweden Email: mattias.borg@eit.lth.se Phone: +46462229099



Research

Research:

My research interests lie in the development of nanotechnology for applications in electronics and neuromorphic computing. I do materials-driven research with the aim understand and control the physics and processes involved in realizing new nanoelectronic device concepts.

Ferroelectric memristors: I currently focus on developing ferroelectric tunnel junction memristive devices based on HfO2 thin films, and their integration with III-V semiconductors. I am exploring the ability of these devices to function as synapses in artificial neuromorphic systems.

3D heterointegration: I explore how to integrate III-V nanostructures into the back-end-of-line in Si CMOS technology, using novel epitaxial methodologies with low thermal budget, based on Rapid Melt Growth and Template-Assisted Selective Epitaxy.

Previously: I pioneered antimonide-based nanowire synthesis during my PhD work, I have been strongly involved in InAs/GaSb-based tunnel field effect transistor (TFET) research both in Lund and at IBM, and at IBM I co-invented a novel method for CMOS-compatible III-V integration on Si, called Template-Assisted Selective Epitaxy (TASE). Teaching at LTH:

Memory technology for Machine Learning (EITP25)

The purpose of this course is to give an in depth understanding for the physics of common memory device technologies with focus on non-volatile memories. Furthermore, the course covers how these memory devices can be integrated to create neuromorphic hardware for applications in machine learning and artificial intelligence. Finally, the course gives an introduction to the architectures and algorithms that are used in machine learning, to give a basic understanding for the needs that memory devices and their connections need to fulfil.

Electronics (EITA35)

This is the first course of the E program, aiming to provide an introduction to Electronics both at a theoretical and practical level.

Qualifications

Nanoelectronics, Readership, Readership in Nanoelectronics, Lund University Award Date: 2018 Feb 20

Employment

Principal investigator NanoLund: Centre for Nanoscience Lund University Lund, Sweden 2016 Mar 1 → present

Profile area member LTH Profile Area: Nanoscience and Semiconductor Technology Lund University Sweden 2022 Aug 30 → present

Profile area member

LU Profile Area: Light and Materials Lund University Sweden 2023 Jan 1 → present

Project manager, Senior lecturer

Electromagnetics and Nanoelectronics Lund University Sweden 2024 May 31 → present

Master Researcher

Ericsson AB Sweden 2022 Mar 1 → present

Research Staff Member

IBM Research Zurich Rüschlikon, Switzerland 2014 Jun 1 → 2016 Feb 29

Post doctoral researcher

IBM Research Zurich Rüschlikon, Switzerland 2012 May 27 → 2014 May 29

Activities

Simulations of current transport phenomena in ferroelectric tunnel junctions Borg, M. (First/primary/lead supervisor) & Lind, E. (Examiner) 2022 Jan \rightarrow 2022 Jun

Semiconducting TiO2 for High Performance Ferroelectric Tunnel Junctions Borg, M. (First/primary/lead supervisor), Atle, R. (Second supervisor) & Lind, E. (Examiner) 2022 → ...

Hub AI: Brain-Inspired Computing Wisbrant, J. (Organiser), Borg, M. (Speaker), Wernersson, L.-E. (Speaker), Heinze, S. (Speaker) & Winge, D. (Speaker) 2021 Dec 6

Automating Feature-Extraction for Camera Calibration Through Machine Learning and Computer Vision Borg, M. (First/primary/lead supervisor) & Åström, K. (Second supervisor) 2021 Jun 15

Stochastic spiking neural networks based on ferroelectric memory devices

Borg, M. (First/primary/lead supervisor) 2021 May 31

Al Lund lunch seminar: In-memory computing to solve Al's energy consumption bottle-neck Wisbrant, J. (Organiser), Wisbrant, J. (Chair) & Borg, M. (Keynote/plenary speaker) 2021 May 5

Fredrik Lindelöw

Lind, E. (First/primary/lead supervisor), Borg, M. (Joint second supervisor) & Wernersson, L.-E. (Joint second supervisor) 2020 May

Harald Havir

Borg, M. (First/primary/lead supervisor) & Burke, A. (Second supervisor) 2020 Feb \rightarrow 2020 May

Development of Ferroelectric Hafnium Oxide for Negative Capacitance Field Effect Transistors

Borg, M. (First/primary/lead supervisor) 2018 Sept $1 \rightarrow 2019$ Feb 14

Robin Athle

Borg, M. (First/primary/lead supervisor) & Svensson, J. (Second supervisor) 2018 Sept \rightarrow 2019 Feb

Nanotechnology (Journal)

Borg, M. (Advisor) 2018 Jan 1 → 2019 Dec 31

Cezar Zota

Lind, E. (First/primary/lead supervisor), Borg, M. (Joint second supervisor) & Wernersson, L.-E. (Joint second supervisor) 2017 Apr

Sang Lun

Borg, M. (First/primary/lead supervisor) 2017 Jan \rightarrow 2018 Jan

Broadening of length distributions of InAs nanowires

Berdnikov, Y. (Presenter), Dubrovskii, V. G. (Contributor), Sibirev, N. (Contributor), Gomes, U. P. (Contributor), Ercolani, D. (Contributor), Zannier, V. (Contributor), Sorba, L. (Contributor), Schmidtbauer, J. (Contributor), Borg, M. (Contributor), Storm, K. (Contributor), Deppert, K. (Contributor) & Johansson, J. (Contributor) 2017

Device Research Conference (DRC) (Event)

Borg, M. (Editorial board member) 2016 Oct 1 \rightarrow 2019 Jul 1

Andreas Malmgren

Borg, M. (First/primary/lead supervisor) $2016 \rightarrow 2017$

IEEE Transactions on Nanotechnology (Journal) Borg, M. (Associate editor)

2015 Nov 1

Prizes and Distinctions

Göran Linds Pris Borg, M. (Recipient), 2019

Senior IEEE Member

Borg, M. (Recipient), 2022 Jun

SSF ICA-7 Borg, M. (Recipient), 2017 Apr 10

Awards

Ferroelectric Tunnel Junctions at the Ultimate Scaling Limit Borg, M. (PI) Swedish Research Council: SEK3,710,000.00 $2024/01/01 \rightarrow 2028/12/31$

Projects

SEQUENCE: Cryogenic 3D Nanoelectronics (Sense and Readout Electronics Cryogenically Integrated for QUantum ENhanced Computation and Evolving Communication)

Svensson, J. (Administrator), Borg, M. (Researcher), Fhager, L. (Administrator), Lind, E. (CoPI), Wernersson, L.-E. (Project coordinator) & Södergren, L. (Research student) 2020/01/01 → 2023/12/31

Ferroelectric Tunnel Junctions at the Ultimate Scaling Limit

Borg, M. (PI) Swedish Research Council 2024/01/01 → 2028/12/31

III-V Devices for Emerging Electronic Applications

Olausson, P. (Research student), Lind, E. (Supervisor) & Borg, M. (Assistant supervisor) 2019/07/01 \rightarrow 2024/02/23

INSIGHT: Integration of III-V Nanowire Semiconductors for next Generation High Performance CMOS SOC Technologies Wernersson, L.-E. (Project coordinator), Borg, M. (Administrator), Svensson, J. (Researcher), Zota, C. (Research student), Lindelöw, F. (Research student), Jönsson, A. (Research student), Lind, E. (Researcher), Kilpi, O.-P. (Research student), Fhager, L. (Researcher), Andric, S. (Research student) & Hellenbrand, M. (PI) 2015/12/01 → 2019/05/31

Integration of III-V semiconductor on Si by Rapid Melt Growth Menon, H. (Researcher) & Borg, M. (Supervisor)

2018/05/01 → 2023/06/30

MAGMA: Melting into Applied inteGrated MAterials

Borg, M. (PI) & Menon, H. (Research student) Swedish Foundation for Strategic Research, SSF 2017/09/01 \rightarrow 2020/09/01

Robust neuromorphic computing using ferroelectric memristors

Borg, M. (Researcher) Swedish Foundation for Strategic Research, SSF 2022/03/01 \rightarrow 2024/12/31

Ultra-fast thermal processing for next-generation ferroelectric hafnia Borg, M. (PI)

Swedish Research Council 2019/01/01 \rightarrow 2023/12/31