

CURRICULUM VITAE

Thorvald G Andersson

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Present position	Professor in Physics since 2001.01.01. Professor chair in “Electronic Materials” since 2011.09.15
Earlier positions	Associate professor (docent/högskolelektor) 91.07.01 to 00.12.31 Ass. professor (extra docentur) in experimental physics/microelectronics at Chalmers during 85.06.01 to 91.06.30 Acting as professor in experimental physics/microelectronics at the University of Göteborg during nearly two years, 1987.01.01 to 03.31 and 88.01.01 to 89.06.30.
Examination	PhD 1976 and the title docent (ass. Prof.) 1983.
Highlights	I am coauthor of more than 220 Journal articles and have over 2180 citations (June 2012) according to SCI. The 10 most cited papers have about 830 citations together. The h-index is 23. I have one of the most cited paper at MC2, Chalmers, Andersson TG , et al. Applied Physics Letters <u>51</u> (1987) 752 Times Cited: 219. This paper is about the border between the growth of strained layers and and quantum dots. We initiated the (international) research on quantum dots with this paper, and a paper about strained QW layers: “Photoluminescence and Photoconductivity Measurements on Band Edge Offsets in Strained In _x Ga _{1-x} As/GaAs Quantum Well Heterostructures Grown by MBE”, T. G. Andersson , et al, Phys. Rev. <u>B37</u> (1988-I) 4032 A following paper about TEM on thin InGaAs-layers on GaAs:

Structure of Lattice-Strained $\text{In}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$ Layers studied by Transmission Electron Microscopy, J Y Yao, **T G Andersson** and G L Dunlop, *Appl Phys Lett.* 53 (1988) 1420.

I got a high ranking in the recent “*Evaluation of the Swedish Condensed Matter Physics 2005:12*” by the Swedish Research Council <http://www.vr.se/publikationer/sida.jsp?resourceId=1105>. About 170 grant holders were evaluated. My name was cited 8 times and only 6 scientists in Sweden were cited more (9 to 17 times) in the report.

Best business idea (Bäst affärsidé) in Venture Cup 98/99 Väst, about RGB-displayer (among 187 contributions), 1998.

ELFAs forskningsstiftelse för RGB-displayer, 1999.

A project idea from me was initiated within the Chalmers School of Entrepreneurship, 2010. Four students worked on the project which resulted in a school company – Quascade for development of short wavelength quantum cascade lasers.

Got 100 000 SEK in 2009 from “Teknikbrostiftelsen” for business development of the quantum cascade laser.

I got 3rd price in “Lärosätenas Ideetävling Väst” 2011 for the Quantum Cascade laser for short wavelengths.

Main scientific activity

Thin Films and Materials Physics. Research on molecular beam epitaxy growth of III-V-compounds. Electrical, structural and optical properties of semiconductor quantum structures based on arsenides, antimonides and nitrides of Ga-, Al- and In-compounds. Studies of advanced device concepts based on nm- and quantum structures and growth of material for device groups. The research also includes material analysis of thin metal films.

Group

The current research project concerns intersubband transitions in AlN/GaN. Besides this Ass. Prof Tommy Ive is working on oxide and nitride layer semiconductors.

Teaching experience

I have 30 years of research/teaching experience.

For the last 20 years I annually give a course in "*Semiconductor Materials*" for graduate and undergraduate students. This contains: basic semiconductor physics, an overview of different semiconductors and their characteristic physical properties such as electronic, electrical, structural and optical characteristics. The course also covers a detailed description of epitaxial techniques, heterostructure physics and the use of hetero-

structures, semiconductor quantum structures, basic device structures and finally the introduction to organic electronics. I have prepared a 230 pages compendium, with a 150 pages supplementary.

<http://fy.chalmers.se/mbe/SemiCourse.html>

In 2008 I started a new course “Molecular Electronics” together with two other scientists at Chalmers.

For graduate students I give a course in "*Epitaxy*" providing the basis for epitaxial growth of semiconductors such as GaAs, Si, GaN, SiC, etc.

For graduate students I have given a course in "*Wide band gap semiconductors*" providing the basic physics for especially GaN, including physics, processing and devices and "*Light emitting materials and devices*".

Examination

I have served as Opponent two times in PhD-examinations.

I have been a member in the examination board for more than 15 PhD-examinations in Göteborg, Stockholm and Linköping in Sweden.

I have been elected expert (reading the thesis) in several international PhD-examinations (Germany, Singapore, Pakistan, etc.).

I have been elected expert (sakkunnig) for applications as assistant, associate and full professors respectively in Sweden and Finland.

Some short term invitations

- Informal invitation (four months) 2014 to Chulalongkorn University Bangkok
- Invited 2013 one month to PSU, Hat Yai, Thailand
- Invited to give a speech at Nanomedicine 2011 (Smart Quantum Dots) November 3-5, Shenzhen, China
- I have an informal collaboration with a group in Australia on “Molecular electronics”.
- International Workshop on Advances in Modeling and Optimization of High Frequency Structures, Reykjavik 2010
- 2nd International Symposium on Flexible Electronics (ISFE 2010) Palma de Mallorca, Spain 2010 (not participated).
- Invited to Cadi Ayyad University, Department of Applied Physics, Optoelectronic Materials Research Team, Marrakech, Morocco, 2009
- Invited talk on “AlN/GaN heterostructures” in Taiwan, 2008
- Invited talk at the workshop on “Flexible electronics” in Spain, 2008
- KHU, Seoul for giving a course and discussions about organic light emitting diodes 2007.

- Invited talk at the SPIE conference in San Jose, California 2007
- KHU, Seoul for giving seminar 2006.
- International Conference on Solid State Ionics, Sri Lanka 2006
- ICMAT 2005: Sym J: III-V Semiconductors for microelectronic and optoelectronic applications, an MRS-conference in Singapore, July 2005
- The 7th IEEE CPMT Conference on High Density Microsystem Design, Packaging and Failure Analysis Electronics in Shanghai, June 2005
- 3rd International Conference on Materials Processing for Properties and performance (MP³) in Singapore, November 2004
- NTU, Singapore several times to School of material science, 2003-2005
- Chulalongkorn University, SPRL, Bangkok, April 2002
- Conference in Singapore on GaInAsN, September 2001
- NCTU Hsinchu, Taiwan, June 2001
- Centre for Optoelectronics, Electrical and Computer Engineering Department, National University of Singapore, Seminar on GaN, September 2000.
- Princeton University, Princeton, USA, Seminar on GaN, April 2000, (prof A Kahn).
- Paul Drude Institute, Berlin, discussion collaborative work on GaN, January 2000 (prof. K Ploog/dr O Brandt);
- Expert Platform Meeting between Universities and SME, Chalmers, May 1999
- Expert Platform Meeting between Universities and SME, Gent, Belgium, April 1999;
- The Instiut für Metallforschung, Münster, Germany (prof N Stolwijk) seminar February 1999;
- The Ångström Laboratory, Uppsala, seminar October 1998 (prof. S Berg); Electrum, Kista, seminar, November 1998;
- Paul Drude Institute, Berlin, work with GaN, 1 week June 1998 (prof. K Ploog);
- Siemens AG, München, Germany, work with GaN, 1 day February 1998 (dr. H Riechert);
- Ericsson Components, seminar, December 1997 (Drs. E Wikborg and J Söderström);
- NTT Basic Research Laboratory, Atsugi, Japan, 1 month October 1997;
- Technical University of Trondheim, opponent on T Worrens PhD-exam, August 1997 (prof. O Hunderi);
- National Symposium on Crystalline Microstructures, Posnan, Polen, invited talk July 1997 (prof M Oszwaldowski);
- Foundation for Research and Technology Hellas (FORTH), Institute for Electronic Structure and Lasers (IESL), Micro-electronics Research Group, Heraklion, Crete, Greece, 1 week July 1997 (dr. A Georgakilos)
- Polish Academy of Science Warsaw, seminars. 1 week July 1997 (prof. A Nadolny);

Long term invitations

Invitations to NTU, Singapore and KHU Seoul, Korea have resulted in several short term trips (weeks) and a long term collaboration (graduate students).

Stayed at KHU Seoul for two months 2007 to give a seminar series.

NTT Basic Research Laboratory, Atsugi, Japan. I worked with MBE-growth (using an RF-source) and characterisation of GaN, 8.5 months during 1995-1996 and 1 month 1997 as visiting professor.

University of Würzburg, Department of Technical Physics. I worked with nm-processing of quantum wires and dots in II-VI materials, ZnSe/CdZnSe on GaAs, 3 months 1994-1995 as researcher.

Jet Propulsion Laboratory, Pasadena California, USA, 3 months 1987.

CNRS, Marseilles, France, 1 month 1982.

Philips Research Laboratory, Redhill, England, 3 months 1978.

International scientific and administrative experience

I have contributed with material to approx. 140 conferences.

I have about 20 invitations for talks in different countries.

I have organised (at Chalmers) the 2:nd International Conference on "Superlattices, Microstructures and Microdevices" 1987

I was elected coordinator for an Esprit-proposal in 1997, within the field of GaN, including 5 countries.

I initiated another proposal to study GaN transistors.

Take part in a "Swedish semiconductor physics program" for development countries: Thailand and Sri Lanka. A student from Peradeniya University, Sri Lanka, Mr Manjula Gurusinghe, visited my group for several years and passed his PhD in 2005.

Member of boards and other administrative work

I was a member of the Editorial Board for Semiconductor Science and Technology, 1990-1993.

I am frequently acting as referee for Applied Physics Letters, Journal of Applied Physics, Journal of Physics, Journal of Crystal Growth, Thin Solid films, Physical Review, Physica Status Solidi and Semiconductor Science and Technology.

Evaluated the contract renewal for Assistant Professor Lam Yeng Ming

in Singapore (2007)

I am regularly refereeing research proposals in different countries (e.g. Australia, Hong Kong, South Africa, Singapore, etc.).

From 1990 I was member of the steering committee (Executive Group) for planning the Microtechnology Center at Chalmers including a ~ 1 000 m² clean room laboratory.

I was the acting member of a Committee for realisation of "Chalmers Material Physics Laboratory". The Laboratory will be open for interdisciplinary projects and outreach to industry and other universities. I have been member of evaluation boards for EU-proposals in Brussels, 1999 and 2000.

I am member of the Board for the Mechanical Workshop and the Liquid He/N₂-laboratory at the Physics Department, Chalmers.

Academic
examination

I have been the main supervisor for several students aiming for Licentiate or PhD-examination. The Lic.-exam is about 50 % of a PhD-exam. Most students have continued with PhD-examination after the Lic. Below is a list of the examined persons.

PhD-examina

List of PhD-examina from my group where I have been the main supervisor for the projects.

- S Norrman, "A Study of Structural and Electrical Properties of Ultrathin Metal films", 1980. Sten Norrman has now his own consulting company in the Microelectronic business and was Manager at MC-2, Chalmers.

- G Landgren "Structure and Properties of the Aluminium-Galliumarsenide Interface Prepared by Molecular Beam Epitaxy", 1982. Gunnar is professor at the department of Electrical Engineering at KTH, Kista, Stockholm.

- S Svensson "Molecular Beam Epitaxy Preparation and Characterisation of Clean and Metallised GaAs (001) Surfaces", 1984. Stefan Svensson is working at the Army Research Laboratory, USA.

- J Söderström "Novel III-V Semiconductor Tunnel Structures Grown by Molecular Beam Epitaxy", 1990. Jan Söderström is General Manager in Opto Electronic Products at Ericsson Components AB, Kista, Stockholm.

- J-Y Yao "Transmission electron microscopy of $\text{In}_x\text{Ga}_{1-x}\text{As}/\text{GaAs}$ strained layer structures", 1990. Ji-Yong Yao is working as lecturer at the University of Queensland, Australia.
- M Ekenstedt "Growth of Strained III-V Semiconductors by Molecular Beam Epitaxy", 1993. Michael Ekenstedt is Director at Saab Bofors Dynamics, Sweden
- W Chen "Quantum-Confined Stark Effect in Artificially made Quantum Well Structures", 1994. Weiquan Chen is working with R&D at Ericsson Development AB, Stockholm.
- S-M Wang "Growth by Molecular Beam Epitaxy of GaAs Related III-V Semiconductors", 1994. Shumin Wang is professor at the MC2-department at Chalmers.
- J Roslund "On the Growth and Properties of $\text{InAs}/\text{Ga}_{1-x}\text{In}_x\text{Sb}$ Superlattices and Related Materials", 1997. Jöran Roslund was a post doc. at NTT Basic Research Laboratory, Atsugi, Japan and is now at Ericsson, Mölndal, Sweden.
- J Thordson "Silicon δ -doping and Isoelectronic Doping in GaAs and GaN Layers Grown by MBE", 1999. Jan Thordson is working at Ericsson, Mölndal, Sweden.
- O Zsebök "Molecular Beam Epitaxy and Characterisation of GaN-Compounds on GaAs (001) and Sapphire (0001)", 2000. Otto Zsebök is in Hungary.
- H Kim "GaN, AlGaN, GaNAs and related Heterostructures Grown by Molecular Beam Epitaxy", 2003. Moved to France.
- M Gurusinge "Electron Transport Limitations in Two and three Dimensions – a study on arsenide and nitride semiconductor heterostructures", 2005. Is working with Thermoelectric coolers.
- F Fälth "Growth, Characterisation and processing of III-Nitride Semiconductors", 2005. Is postdoc in Singapore.
- S Davidsson "Molecular beam epitaxy growth and characterization of GaN, AlN and AlGaN/GaN heterostructures", 2005. Works at Saab Aerotech.
- X Liu "GaN/AlN Multiple quantum well structures - MBE growth and characterisation", 2007. Works at Norstel with SiC.

- Måns Andreasson "Thermal evaporation of small molecules - a study of interfacial, bulk, and device properties for molecular electronics", 2008.

Lic.-examina

List of licentiate-examina from my group where I have been the main supervisor.

- A Rouhani "Processing and Electrical Measurements of Mesa- and Split Gate Wires made of n^+ -GaAs and AlGaAs/GaAs 2-DEG's", 1989. Ali Rouhani is working with R&D at Ericsson Stockholm.

- M Ekenstedt "The Influence of Growth Temperature on the Critical Layer Thickness of Strained Heterostructures Grown by Molecular Beam Epitaxy", 1991.

- M Cumming "Hall Effect Measurements on GaAs and InSb Grown by Molecular Beam Epitaxy", 1991. Malcolm Cumming is teacher at a High School (gymnasium) in Sweden.

- S-M Wang "The Band Offset and the Critical Layer Thickness in III-V Compound Semiconductor Heterostructures", 1992.

- W Chen "Quantum Confined Stark Effect in Different Quantum Well Structures", 1992.

- J Roslund "Low Bandgap Materials based on InAs/GaSb Superlattices", 1994.

- J Thordson "The GaAs/Si/GaAs Heterostructure", 1995. Jan Thordson is presently a PhD-student in my research group working with GaN- and GaAs/Si/GaAs heterostructures .

- O Zsebök "Epitaxial Growth, Processing and Characterisation of III-V Semiconductor Micro- and Nanostructures", 1997

- F Fätlth "Growth of GaN, GaN:Mg and InGaN by Molecular Beam Epitaxy", 2002.

- M Gurusinghe "Electrical Characterization of GaN and AlGaIn/GaN Heterostructures Grown by Molecular Beam Epitaxy", September 2002.

- S Davidsson "Initial growth of GaN on sapphire and growth of AlGaIn on GaN by molecular beam epitaxy", October 2002.

- X Liu "AlN/GaN MQW-structures – MBE-growth and characterisation" December 2004.

- M Andreasson “Small-molecule layers for devices –Evaporation growth and characterization of thin films”, June 2005.
- R Farivar “Molecular beam epitaxy and characterization of AlN/GaN heterostructures”, June 2011.

Other academic supervising I have also been acting as secondary supervisor for a few other students in other research groups.

I have been supervising more than 30 diploma works and been involved in examination of diploma works made in international laboratories (Europe). This is typically 4-6 months work for an undergraduate. Each work results in a thesis, which is typically 30 - 60 pages written in english. The most recent works are:

- "Calculations of δ -potentials", Magnus Preinfalk, 1995.
- "Shubnikov-de Haas Effect", Åke Dahllöf, 1996.
- "Investigations of GaN material and GaN LEDs", Mari Gustafsson, 1997.
- "System for Automatic Evaluation of RHEED-patterns", Christian Dutto, 1998
- "Electrical and optical characterisation of MBE-grown GaN", Régis Difrenza, 1998
- "Materials for IR-devices", Mats Larsson, 1998.
- "Automatic RHEED evaluation applied to GaN heterostructure growth", Robert Gunnarsson, 1999
- "Quantum Well Calculations - A new computer program for scientific and educational purposes", Fredrik Fälth, 2000.
- "Static IV characteristics of high voltage diodes", Dan Kuylenstierna, 2000.
- "Characterisation methods for GaN based heteroepitaxial layers", Andreas Mattsson, 2001.
- "Investigation of the GaN/AlGaIn Interface", 2002, Xinyu Liu (graduate student at Chalmers)
- "Growth of molecular semiconductors by MBE", Philipp Wellman, 2003 (graduate student in Germany)
- "Future display technologies for automotive applications", 2003, Helene Briddle (graduate student at Chalmers)
- "Growth of organic materials for light emitting devices", Huang Qiang 2003 (graduate student in Germany)
- "Growth and characterisation of doped organic semiconductor LED heterostructures", Michael Wank, 2004
- "Basic issues for high quality GaN-growth by MBE – Sapphire substrate annealing and growth temperature calibration" Yun Liu 2005
- "Schottky and ohmic contacts to GaN", Muhammead Shakil Siddique, 2005
- "III-nitride light emitting devices – Material, design and processing issues", John Nilsson, 2005.
- "Modelling and fabrication of organic semiconductor light emitting transistors", Sasa Vuckovic, 2005
- "Characterization of GaN:Mg and InGaIn grown by MBE, Andreas Ekberg, 2006"
- "Growth and characterization of organic light-emitting transistors", Keke Zhang, 2006.
- "Characterization of AlGaIn/GaN heterostructures grown by molecular beam epitaxy" Ndubuisi Benjamin Ukah, 2007
- "Organic photovoltaic cells – A study on the function of the buffer layer" Bregt Verreet 2007
- "Processing of III-nitride light-emitting diodes" Henrik Magnusson 2007
- "Diamond and boron nitride (BN) in electronics" Rashid Farivahr 2008
- "Encapsulation and environmental testing of organic light emitting devices" Hsuan-Yi Liao 2008
- "A study of the organic static induction transistor" Audy Laksmana 2008
- "Charge transport in disordered organic semiconductors" Sebastian de Graaf 2008
- "Organic ferroelectric transistor memories" Nouman Ali 2011
- "MBE growth, substrate temperature homogeneity and characterization of AlN/GaN heterostructures", Farham Farangi 2012

Patent applications	1970 for “Automated switching of scale in electrical measurements” 2011 for “Cladding composition in lattice mismatched nitride-heterostructures”	
Some awards	Bäst affärsidé i Venture Cup 98/99 Väst, om RGB-displayer (among 187 contributions), 1998.	
	ELFAs forskningsstiftelse för RGB-displayer, 1999.	
	Fick 100 000 SEK år 2009 från “Teknikbrostiftelsen” för utveckling av kvantkaskadlaser.	
	Tredje pris “Lärosätenas Ideetävling Väst” 2011 för Kvantkaskadlaser med korta våglängder.	
Formal and informal collaboration	Harvard university Linköping university University of new south Wales, Australia	
Approximate number of scientific papers	In international, refereed Scientific Journals	240
	Contributing conference reports	200
	Book/compendium for teaching	2
	Manuscripts under preparation for Scientific Journals	~5