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# Curriculum Vitae: Dr. rer. nat. Alexander Franke

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## Profile

I'm a semiconductor scientist with passion in photonics. My endeavors are focused on the engineering of optoelectronic and photonic devices to provide the next generation light sources tailored to communication, sensing, and lighting applications as well as single photon emitters required for quantum cryptography and quantum computing. My research activities at forefront university institutions in Germany and the United States and collaboration with cutting edge international companies and research institutions allowed me to develop profound expertise covering multidisciplinary fields - crystal growth and thin film deposition, nanotechnology, semiconductor device simulation, fabrication and their structural and optical characterization.

My current work is focused on the development and fundamental research on nitride vertical emitting ultra-violet lasers qualified for a weak and strong interaction of light with matter.

- main research interests: wide bandgap semiconductors, fabrication and characterization of photonic and optoelectronic devices, semiconductor nanostructures, thin film deposition techniques, high resolution spectroscopy
- strong experimental, technical and theoretical background, teaching and supervision experience, leadership skills and capable to work in a team, excellent ability to consider priorities and solve tasks

## Identification

date of birth: 25<sup>th</sup> of February 1982  
place of birth: Halle, Germany  
email: alexander\_franke@gmx.net

## Education

Feb. 2007 - Apr. 2013 **Doctorate (Dr. rer. nat.)** - magna cum laude  
*Department of Experimental Physics, Otto-von-Guericke-University  
Magdeburg, Germany*  
Specialization: optical properties and light-matter coupling in semiconductor  
micro/nano-structures  
Thesis: "Light-matter-coupling in nitride microcavities"

Oct. 2001 - Jan. 2007 **Study of physics (Diplom)** - very good  
*Department of Experimental Physics, Otto-von-Guericke-University  
Magdeburg, Germany*  
Specialization: condensed matter / solid state physics / semiconductor physics  
Thesis: "Luminescence investigations of microcavity and VCSEL  
structures in the blue and ultra-violet spectral range"

## Work experience

- Apr. 2015 - Dec. 2016 **Fellowship of National Academies of Sciences:**  
*Department of Materials Science and Engineering, North Carolina State University, Raleigh, NC, USA*
- project management: “Fabrication of ultra-low threshold nitride UV surface emitting laser“ - design, simulation, fabrication, and characterization of vertical emitting laser structures (VCSEL and polariton laser)
- Feb. 2014 - Apr. 2015 **Postdoctoral Researcher / Research Associate**  
*Department of Materials Science and Engineering, North Carolina State University, Raleigh, NC, USA*
- Simulation and epitaxial growth of Group-III-Nitride semiconductor films and Bragg reflectors for ultra-violet (UV) vertical emitting laser devices
  - supervision of PhD and master students, teaching
- Feb 2013 - Feb. 2014 **Postdoctoral Researcher / Research Associate**  
*Department of solid state physics at the Technische Universität Berlin (TU Berlin), Germany*
- project: „Nanostructured Efficient White LEDs (NEWLED) - optical characterization of semiconductor nanostructures
  - supervision of Master and Bachelor students
- Jan. 2007 - Feb. 2013 **Research Associate**  
*Department of Experimental Physics, Otto-von-Guericke-University Magdeburg, Germany*
- design, fabrication and characterization of vertical emitting laser structures for the visible and ultra-violet spectral range
  - manager of spectroscopy laboratory at department of solid state physics
  - fundamental research on polaritons for the development of polariton lasers
  - structural and optical analysis of optoelectronic devices
  - supervision of physics students (diploma degree), teaching

## Teaching experience

- Feb. 2014 - Dec. 2016 **Assistant** for graduate course “Interaction of Electrons with Materials” and “Interaction of Photons with Materials”,  
*North Carolina State University, Raleigh, NC, USA*
- Oct. 2009 - Jan. 2013 **Assistant** for undergraduate course: “Physics for Engineers” and applied physics laboratory course for physicists and engineers  
*Otto-von-Guericke-University Magdeburg, Germany*
- Apr. 2009 - Oct. 2008 **Lecturer** of course “Technical Optics”  
*Otto-von-Guericke-University Magdeburg, Germany*
- Apr. 2007 - Sep. 2008 **Teaching assistant** for 3<sup>rd</sup> and 4<sup>th</sup> year undergraduate physics course  
*Otto-von-Guericke-University Magdeburg, Germany*
- Nov. 2004 - Dec. 2005 **Teaching assistant** for undergraduate applied physics laboratory course  
*Otto-von-Guericke-University Magdeburg, Germany*

## **Fellowships/ Certificates**

2015	Fellowship of National Academies of Sciences of United States of America
2015	Certificate in Teaching Techniques, North Carolina State University
2014	Certificate of Training: "Management Bootcamp"

## **Scientific and University Organization**

since 2000	Membership of "Deutsche Physikalische Gesellschaft" (DPG)
Jun. 2014 - Dec. 2016	International officer of Postdoctoral Association <i>North Carolina State University, Raleigh, NC</i> - represent and support international postdoctoral students at NC State University

## Patent

### 2016

M. Gerhold, **A. Franke**, R. Kirste, D. Alden, Z. Sitar, R. Collazo, “*Monolithic micro-pillar photonic cavities based on III-nitrides materials*”, U.S. patent disclosure, Jan. 2016

## Publications

### 2016

- [18] F. Kaess, P. Reddy, D. Alden, A. Klump, L.H. Hernandez-Balderrama, **A. Franke**, R. Kirste, A. Hoffmann, R. Collazo, Z. Sitar, “*The Effect of Illumination Power Density on Carbon Defect Configuration in Silicon doped GaN*”, Journal of Applied Physics 120, 235705 (2016)
- [17] N. Berg, **A. Franke**, R. Kirste, R. Collazo, A. Ivanisevic, “*Photoluminescence Changes of III-Nitride lateral Polarity Structures after Chemical Functionalization*”, Materials Research Express 3, 12 (2016)
- [16] **A. Franke**, M.P. Hoffmann, R. Kirste, M. Bobea, J. Tweedie, F. Kaess, M. Gerhold, R. Collazo, Z. Sitar, “*High reflectivity III-nitride UV-C distributed Bragg reflectors for vertical cavity emitting lasers*”, Journal of Applied Physics, 120, 13, 135703 (2016)
- [15] F. Kaess, S. Mita, J. Xie, P. Reddy, A. Klump, L.H. Hernandez-Balderrama, S. Washiyama, **A. Franke**, R. Kirste, A. Hoffmann, R. Collazo, Z. Sitar, “*Correlation between mobility collapse and carbon impurities in Si-doped GaN grown by low pressure metalorganic chemical vapor deposition*”, Journal of Applied Physics, 120, 10, 105701 (2016)
- [14] D. Alden, W. Guo, R. Kirste, F. Kaess, I. Bryan, T. Troha, A. Bagal, P. Reddy, L.H. Hernandez-Balderrama, **A. Franke**, S. Mita, C-H. Chang, A. Hoffmann, M. Zgonik, R. Collazo, Z. Sitar, “*Fabrication and structural properties of AlN submicron periodic lateral polar structures and waveguides for UV-C applications*”, Applied Physics Letters, 108, 26, 261106 (2016)
- [13] P. Reddy, S. Washiyama, F. Kaess, M.H. Breckenridge, L.H. Hernandez-Balderrama, B.B. Haidet, D. Alden, **A. Franke**, B. Sarkar, E. Kohn, R. Collazo, Z. Sitar, “*High temperature and low pressure chemical vapor phase deposition of silicon nitride on AlGaIn: Band offsets and passivation studies*”, Journal of Applied Physics, 119, 14, 145702 (2016)
- [12] **A. Franke**, M.P. Hoffmann, L.H. Hernandez-Balderrama, F. Kaess, I. Bryan, S. Washiyama, M. Bobea, J. Tweedie, R. Kirste, M. Gerhold, R. Collazo, Z. Sitar, “*Strain engineered high reflectivity DBRs in the deep UV*”, Proc. SPIE 9748 (2016)
- [11] F. Güell, P.R. Martínez-Alanis, S. Khachadorian, R.R. Zamani, **A. Franke**, A. Hoffmann, M.R. Wagner, G. Santana, “*Spatially controlled growth of highly crystalline ZnO nanowires by an inkjet-printing catalyst-free method*”, Materials Research Express, 3, 4, 025010 (2016)
- [10] F. Güell, P.R. Martinez-Alanis, S. Khachadorian, J. Rubio-Garcia, **A. Franke**, A. Hoffmann, G. Santana, “*Raman and photoluminescence properties of ZnO nanowires grown by a catalyst-free vapor-transport process using ZnO nanoparticle seeds*”, Physica Status Solidi (b) 253, 5, 883-888 (2016)

## 2015

- [9] A. Majkić, U. Puc, **A. Franke**, R. Kirste, R. Collazo, Z. Sitar, M. Zgonik, “*Optical properties of aluminum nitride single crystal in the THz region*”, Optical Materials Express, 5, 10, 2106-2111 (2015)
- [8] S. Okur, **A. Franke**, F. Zhang, V. Avrutin, H. Morcoc, F. Bertram, J. Christen, Ü. Özgür, “*Strong exciton-photon coupling in hybrid InGaN-based microcavities on GaN substrate*”, Proc. SPIE; 9363 (2015)
- [7] S. Okur, R. Shimada, F. Zhang, S.D.A. Hafiz, J. Lee, V. Avrutin, Ü. Özgür, H. Morkoç, **A. Franke**, F. Bertram, and J. Christen, “*GaN-Based Vertical Cavities with All Dielectric Reflectors by Epitaxial Lateral Overgrowth*”, Japanese Journal of Applied Physics 52, 08JH03 (2013)

## 2012

- [6] **A. Franke**, B. Bastek, S. Sterling, O. August, S. Petzold, P. Veit, J. Christen, P. Moser, M. Wieneke, C. Berger, J. Blaesing, A. Dadgar, and A. Krost, “*Optical characterization of a InGaN/GaN microcavity with epitaxial AlInN/GaN bottom DBR*”, MRS Proceedings, 20121396 (2012)
- [5] C. Berger, A. Dadgar, J. Blaesing, **A. Franke**, T. Hempel, R. Goldhahn, J. Christen, and A. Krost, “*Growth of AlInN/AlGaIn distributed Bragg reflectors for high quality microcavities*”, Physica Status Solidi (c) 9, 5, 1253-1258 (2012)

## 2011

- [4] **A. Franke**, B. Bastek, J. Krimmling, J. Christen, P. Moser, A. Dadgar, A. Krost, “*Optical investigation of a hybrid GaN based microcavity with AlInN/GaN bottom and dielectric top distributed Bragg mirror*”, Superlattices and Microstructures 49, 187–192 (2011)

## 2010

- [3] A. Krost, C. Berger, J. Blaesing, **A. Franke**, T. Hempel, A. Dadgar, and J. Christen, “*Strain evaluation in AlInN/GaN Bragg mirrors by in situ curvature measurements and ex situ x-ray grazing incidence and transmission scattering*”, Applied Physics Letters 97, 181105 (2010)
- [2] V.K.X. Lin, S. Tripathy, S. L. Teo, S. B. Dolmanan, A. Dadgar, M. Noltemeyer, **A. Franke**, F. Bertram, J. Christen, and A. Krost, “*Luminescence Properties of Photonic Crystal InGaN/GaN Light Emitting Layers on Silicon-on-Insulator*”, Electrochemical and Solid-State Letters 13, H343 (2010)

## 2009

- [1] C. Hums, A. Gadanez, A. Dadgar, J. Blasing, P. Lorenz, S. Krischok, F. Bertram, **A. Franke**, J.A. Schaefer, J. Christen, A. Krost, “*AlInN/GaN based multi quantum well structures - growth and optical properties*”, Physica Status Solidi (c) 6, 2, S451-S454 (2009)

## **Presentations (selected)**

### **2016**

**A. Franke**, F. Kaess, M.P. Hoffmann, J. Tweedie, R. Kirste, M. Bobea-Graziano, E. Sachet, J.-P. Maria, M. Gerhold, R. Collazo, Z. Sitar, "*AlGa<sub>N</sub> DBR and microcavities for deep UV vertical emitting laser*", International Workshop on Nitride Semiconductors 2016, Orlando, USA

**A. Franke**, D. Alden, R. Kirste, J. Tweedie, F. Kaess, M.P. Hoffmann, M. Gerhold, R. Collazo, Z. Sitar, "*Nitride micro-columnar DBR and monolithic microcavities for the UV-C spectral range*", International Workshop on Nitride Semiconductors 2016, Orlando, USA

**A. Franke**, "*Laser: Conquer the dark side of the force*", "Science on stage", North Carolina Museum of Natural Sciences, Raleigh, USA

**A. Franke**, L. Hernandez, F. Kaess, M.P. Hoffmann, I. Bryan, Z. Bryan, M. Bobea, J. Tweedie, R. Kirste, E. Sachet, J.-P. Maria, M. Gerhold, R. Collazo, Z. Sitar, "*Strain engineered high reflectivity DBRs and microcavities in the deep UV*", SPIE Photonics West, San Francisco, USA

### **2015**

**A. Franke**, M.P. Hoffmann, I. Bryan, Z. Bryan, M. Bobea, J. Tweedie, F. Kaess, R. Kirste, L. Hernandez, M. Gerhold, R. Collazo, Z. Sitar, "*Strain optimized high reflective Nitride DBRs for Deep-UV applications*", 6th International Symposium on Growth of III-Nitrides, Hamamatsu, Japan

**A. Franke**, M.P. Hoffmann, I. Bryan, Z. Bryan, M. Bobea, J. Tweedie, F. Kaess, R. Kirste, C. Shelton, J.-P. Maria, M. Gerhold, R. Collazo, and Z. Sitar, "*All nitride confinement structures for deep UV microcavity laser*", SPIE Photonics West, San Francisco, USA

### **2014**

**A. Franke**, M.P. Hoffmann, I. Bryan, Z. Bryan, M. Bobea, J. Tweedie, F. Kaess, R. Kirste, C. Shelton, J.-P. Maria, M. Gerhold, R. Collazo, Z. Sitar, "*AlN/AlGa<sub>N</sub> Distributed Bragg Reflectors for the Deep UV Spectral Range*", International Workshop on Nitride Semiconductors 2014, Wrocław, Poland

**A. Franke**, M.P. Hoffmann, I. Bryan, Z. Bryan, M. Bobea, J. Tweedie, F. Kaess, R. Kirste, C. Shelton, J.-P. Maria, M. Gerhold, R. Collazo, and Z. Sitar, "*High reflectivity AlN/AlGa<sub>N</sub> DBR suitable for vertical UV emitting laser structures*", Materials Research Society (MRS) Fall Meeting, Boston, USA

### **2011**

**A. Franke**, B. Bastek, O. August, S. Sterling, T. Hempel, J. Christen, P. Moser, J. Blaessing, Ch. Berger, A. Dadgar, and A. Krost, "*Optical and structural characterization of a GaN based semi-microcavity with AlInN/GaN bottom distributed Bragg mirror*", 11th International Conference on Physics of Light-Matter Coupling in Nanostructures, Berlin, Germany

**A. Franke**, B. Bastek, S. Petzold, J. Christen, P. Moser, C. Berger, J. Bläsing, A. Dadgar, and A. Krost, "*Optical characterization of a hybrid InGa<sub>N</sub>/GaN microcavity with epitaxial AlInN/GaN bottom DBR*", Materials Research Society (MRS) Fall Meeting, Boston, USA

## 2010

**A. Franke**, B. Bastek, J. Krimmling, T. Hempel, J. Christen, P. Moser, A. Dadgar, and A. Krost, “*Optical characterization of a hybrid InGaN/GaN microcavity consisting of an epitaxial grown bottom and dielectric top distributed Bragg mirror*”, International Nano-Optoelectronics Workshop 2010, Beijing and Changchun, China

**A. Franke**, B. Bastek, J. Krimmling, J. Christen, P. Moser, A. Dadgar, and A. Krost, “*Optical investigation of a hybrid GaN based microcavity with AlInN/GaN bottom and dielectric top distributed Bragg mirrors*”, 10th International Conference on Physics of Light-Matter Coupling in Nanostructures, Cuernavaca, Mexico

**A. Franke**, S. Sterling, J. Christen, P. Moser, A. Dadgar, A. Krost, “*Characterization of a hybrid GaN microcavity structure with an AlInN/GaN bottom DBR and an InGaN/GaN MQW active region*”, International Workshop on Nitride Semiconductors 2010, Tampa, USA

## 2008

**A. Franke**, J. Krimmling, B. Bastek, T. Hempel, J. Christen, P. Moser, A. Dadgar, and A. Krost, “*Luminescence characterization of a hybrid GaN/InGaN microcavity structure confined between AlInN/GaN and dielectric Bragg reflectors*”, International Workshop on Nitride Semiconductors, Montreux, Switzerland

**A. Franke**, J. Krimmling, M. Noltemeyer, J. Christen, A. Dadgar, A. Krost, V.K.X. Lin, S.L. Teo, S. J. Chua, S. Tripathy, “*Optical Characterization of photonic crystal GaN LED structures on SOI substrate*”, International Workshop on Nitride Semiconductors, Montreux, Switzerland

**A. Franke**, F. Bertram, J. Christen, A. Dadgar, A. Krost, X.K. Lin, S.L. Teo, S. Tripathy, “*Microscopic luminescence characterization of InGaN/GaN micro-disk LEDs on silicon: 3D stress distribution and optical confinement*”, 8th International Conference on Physics of Light-Matter Coupling in Nanostructures, Tokyo, Japan

## 2007

**A. Franke**, B. Bastek, M. Noltemeyer, F. Bertram, J. Christen, M. Wieneke, A. Dadgar, A. Krost, R. Kirste, U. Harboeck, A. Hoffmann, “*Optical Properties of High Quality MOVPE Grown Non-Polar a-Plane GaN Epilayers*”, 7th International Conference on Nitride Semiconductors, Las Vegas, USA

## 2006

**A. Franke**, S. Petzold, T. Hempel, F. Bertram, J. Christen, E. Feltin, N. Grandjean, “*Observation of coupled exciton-photon mode splitting in nitride semiconductor microcavities*”, 6th International Conference on Physics of Light-Matter Coupling in Nanostructures, Magdeburg, Germany

**A. Franke**, A. Diez, S. Petzold, B. Diez, T. Hempel, J. Christen, A. Dadgar, A. Krost, “*Ta<sub>2</sub>O<sub>5</sub> / SiO<sub>2</sub> dielectric DBR mirrors for realization of ZnO VCSEL structures*”, 6th International Conference on Physics of Light-Matter Coupling in Nanostructures, Magdeburg, Germany

**A. Franke**, A. Diez, S. Petzold, B. Diez, T. Hempel, J. Christen, A. Dadgar, A. Krost, “*ZnO VCSEL structures with Ta<sub>2</sub>O<sub>5</sub> / SiO<sub>2</sub> dielectric DBR mirrors*”, 4th International Workshop on ZnO and related Materials, Giessen, Germany