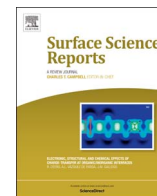




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journal homepage: www.elsevier.com/locate/surfrepThe fundamental surface science of wurtzite gallium nitride[☆]V.M. Bermudez¹

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ABSTRACT

A review is presented that covers the experimental and theoretical literature relating to the preparation, electronic structure and chemical and physical properties of the surfaces of the wurtzite form of GaN. The discussion includes the adsorption of various chemical elements and of inorganic, organometallic and organic species. The focus is on work that contributes to a microscopic, atomistic understanding of GaN surfaces and interfaces, and the review concludes with an assessment of possible future directions.

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Contents

1. Introduction	3
2. The ideally-terminated surfaces	4
3. Preparation of clean surfaces (<i>ex-situ</i> growth / <i>in-situ</i> cleaning)	7
3.1. <i>Ex-situ</i> wet-chemical pre-treatment	8
3.2. <i>In-situ</i> chemical cleaning	11
3.2.1. Ga deposition and desorption	11
3.2.2. Annealing in NH ₃ vapor	13
3.3. <i>In-situ</i> ion bombardment and annealing and related topics	14
3.3.1. Faceting	14
3.3.2. Annealing only	15
3.3.3. Ion-beam damage	15
3.3.4. Ion bombardment and annealing	16
3.4. Other methods	17

Abbreviations: 2D, Two-Dimensional; 2DEG, Two-Dimensional Electron Gas; 2DPS, Two-Dimensionally-Periodic Slab; 3D, Three-Dimensional; AES, Auger Electron Spectroscopy; AFM, Atomic Force Microscopy; ARUPS, Angle-Resolved Ultraviolet Photoemission Spectroscopy; B3LYP, Becke-3 Lee-Yang-Parr; BB, Band Bending; BE, Binding Energy; BEP, Beam-Equivalent Pressure; BZ, Brillouin Zone; CBED, Convergent-Beam Electron Diffraction; CBM, Conduction Band Minimum; CMP, Chemo-Mechanical Polishing; C-V, Capacitance-Voltage; CVD, Chemical Vapor Deposition; DB, Dangling Bond; DFT, Density Functional Theory; DFTB, Density Functional Tight Binding; DI, Deionized (H₂O); DOS, Density of States; ECR, Electron Counting Rule; EDAX, Energy-Dispersive Analysis by X-rays; ELS, (Electron) Energy Loss Spectroscopy; ESD, Electron-Stimulated Desorption; FCC, Face-Centered Cubic; FK, Fuchs-Kliewer; FLAPW, Full-Potential Linearized Augmented Plane Wave; GGA, Generalized Gradient Approximation; HCP, Hexagonal Close-Packed; HOMO, Highest Occupied Molecular Orbital; HREELS, High-Resolution Electron Energy Loss Spectroscopy; HRTEM, High-Resolution Transmission Electron Microscopy; HSE, Heyd-Scuseria-Ernzerhoff; IBA, Ion Bombardment and Annealing; IPES, Inverse Photoemission Spectroscopy; ISS, Ion-Scattering Spectroscopy; I-V, Current-Voltage; KE, Kinetic Energy; LDA, Local Density Approximation; LEED, Low-Energy Electron Diffraction; LEEM, Low-Energy Electron Microscopy; MBE, Molecular Beam Epitaxy; MD, Molecular Dynamics; MIGS, Metal-Induced Gap States; ML, Monolayer; MOCVD, Metal-Organic Chemical Vapor Deposition; MOVPE, Metal-Organic Vapor-Phase Epitaxy; NBLP, Non-Bonding Lone Pair (Orbital); NCPP, Norm-Conserving Pseudopotential; NEA, Negative Electron Affinity; NEB, Nudged Elastic Band; NLCC, Non-Linear Core Correction; PAW, Projector Augmented Wave; PBE, Perdew-Burke-Ernzerhoff; PED, Photoelectron Diffraction; PH, Pseudo-Hydrogen; PL, Photoluminescence (Spectroscopy); PP, Pseudopotential; PW, Plane Wave; PW-91, Perdew-Wang 1991; QCO, Quartz Crystal Oscillator; RAS, Reflection-Absorption Spectroscopy; RBS, Rutherford Backscattering; RHEED, Reflection High-Energy Electron Diffraction; RHF, Restricted Hartree Fock; RMS, Root Mean Square; RPES, Resonant Photoemission Spectroscopy; RT, Room Temperature; SAM, Self-Assembled Monolayer; SBH, Schottky Barrier Height; SCL, Space-Charge Layer; SCLS, Surface Core-Level Shift; SE, Spectroscopic Ellipsometry; SIMS, Secondary-Ion Mass Spectroscopy; SPV, Surface Photovoltage (or Surface Photovoltaic); STM, Scanning Tunneling Microscopy; STS, Scanning Tunneling Spectroscopy; SUC, Surface Unit Cell; TEG, Triethylgallium; TEM, Transmission Electron Microscopy; TCE, Trichloroethylene; TMG, Trimethylgallium; TOF-SARS, Time-of-Flight Scattering and Recoil Spectroscopy; TPD, Temperature-Programmed Desorption; UHV, Ultra-High Vacuum; UPS, Ultraviolet Photoemission Spectroscopy; USPP, Ultra-Soft Pseudopotential; UV, Ultraviolet; VBM, Valence Band Maximum; VPE, Vapor-Phase Epitaxy; XAES, X-ray-(Excited) Auger Electron Spectroscopy; XPS, X-ray Photoemission Spectroscopy; XRD, X-ray Diffraction.

[☆]The views presented are those of the author and do not necessarily represent the views of the Department of Defense or its Components.

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3.5.	Summary	17
4.	Structure and properties of clean surfaces	18
4.1.	Theoretical background	18
4.1.1.	Calculations at $T = 0$	18
4.1.2.	Calculations at finite temperature	21
4.2.	Polarity and polarization	22
4.2.1.	Polarity	22
4.2.2.	Polarization	23
4.3.	Surface morphology	24
4.4.	Defects, strain and other imperfections	27
4.5.	Thermal stability and decomposition	28
4.6.	Stoichiometry and reconstruction (AES, ISS, XPS, LEED, RHEED, STM)	29
4.6.1.	The (0001) surface	29
4.6.2.	The (000 $\bar{1}$) surface	35
4.6.3.	The (10 $\bar{1}$ 0) and (11 $\bar{2}$ 0) surfaces	37
4.6.4.	Semi-polar surfaces	39
4.7.	Spectroscopy and surface electronic structure (UPS, ELS, STS)	42
4.7.1.	Ultraviolet photoemission spectroscopy	42
4.7.2.	Electron Energy Loss Spectroscopy and related methods	56
4.7.3.	Band bending and surface photovoltage	58
4.8.	Vibrational properties and free-electron excitation	65
5.	The chemical elements - adsorption and interfaces	65
5.1.	Aluminum	66
5.2.	Antimony	70
5.3.	Arsenic	71
5.4.	Barium	72
5.5.	Beryllium	73
5.6.	Bismuth	73
5.7.	Boron	73
5.8.	Carbon	73
5.9.	Cerium	75
5.10.	Cesium	75
5.11.	Chlorine	77
5.12.	Chromium	78
5.13.	Cobalt	78
5.14.	Copper	80
5.15.	Europium	80
5.16.	Fluorine	80
5.17.	Gadolinium	81
5.18.	Gallium	81
5.19.	Germanium	86
5.20.	Gold	86
5.21.	Hafnium	89
5.22.	Indium	89
5.23.	Iron	91
5.24.	Lead	93
5.25.	Magnesium	93
5.26.	Manganese	99
5.27.	Nickel	102
5.28.	Niobium	106
5.29.	Palladium	106
5.30.	Platinum	107
5.31.	Ruthenium	108
5.32.	Samarium	109
5.33.	Scandium	109
5.34.	Silicon	110
5.35.	Silver	113
5.36.	Sulfur	114
5.37.	Titanium	115
5.38.	Vanadium	116
5.39.	Zirconium	116
6.	Metal contacts	117
7.	Adsorption of inorganic and organometallic molecules	120
7.1.	Ammonia (NH_3)	120
7.2.	Hydrazine (N_2H_4)	125
7.3.	Hydrogen (H and H_2)	125
7.4.	Hydrogen chloride (HCl) and gallium monochloride (GaCl)	133
7.5.	Nitric oxide (NO)	134
7.6.	Nitrogen (N and N_2)	134
7.7.	Nitrous oxide (N_2O)	137
7.8.	Oxygen (O and O_2) and ozone (O_3)	137
7.9.	Trimethylgallium ($\text{Ga}(\text{CH}_3)_3$), triethylgallium ($\text{Ga}(\text{C}_2\text{H}_5)_3$), etc	143

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