ASN Module (mandatory)

Academic Skills Development

(Scientific Communication)

Prof. R. Goldhahn
(*Department Material Physics*)

ruediger.goldhahn@ovgu.de

Modules and time schedule

		Specialization phase						Research phase						Examination schedule			
		1st semester			2nd semester			3rd semester			4th semester			SWS	CP	LN	PF
		19		30	17		30	13		30	0		30	49	120		
No	Compulsory modules[1]	SWS	Kind	CP	SWS	Kind	CP	SWS	Kind	CP	SWS	Kind	CP				
1	Entrance Harmonization Course[1] 1/2	3	V+Ü	5										3	5		M,K[5]
2	Entrance Harmonization Course[1] 2/2	3	V+Ü	5										3	5		M,K[5]
3	Solid-state physics	3	V+Ü	5										3	5		M,K[5]
4	Semiconductor quantum structures				3	V+Ü	5							3	5		M,K[5]
5	Semiconductor Devices I				3	V+Ü	5							3	5		M,K[5]
6	Semiconductor Devices II							3	V+Ü	5				3	5		M,K[5]
7	Semiconductor Process Technologies				2	V	5							2	5		M,K[5]
8	Advanced semiconductor characterization				3	V+S	5							3	5		M,K[5]
9	Advanced electronic circuits							3	V+Ü	5				3	5		M,K[5]
10	Machine learning	4	V+Ü	5										4	5		M,K[5]
11	Cleanroom lab course				3	P	5							3	5	*	ÜL
12	Academic Skills Development							4	S	5				4	5	*	SV
13	Introduction to Research								Wip	10				0	10	*	SV
14	Master's thesis												30	0	30		
	Compulsory electable modules[3]													6	10		
15	Physical/Technical Module 1	3	V+Ü	5										3	5		M,K[5]
16	Physical/Technical Module 2				3	V+Ü	5							3	5		M,K[5]
	Non-technical electable module[4]													6	10		
17	Non-technical module 1	3	V+Ü	5										3	5		M,K[5]
18	Non-technical module 2							3	V+Ü	5				3	5		M,K[5]

Aims, content. examination

- Participants acquire knowledge in current research topics by studying available literature and convert that knowledge into an introductory presentation for a scientific audience.
- They prepare themselves to be able to discuss relevant scientific aspects of their talk.
- Thereby, students become mature of free speech in scientific discussions, conferences, meetings and workshops.

- **Current topics of research**

- Presentation and discussion of current research topics (30 min)

NP 01: Nobel Prize in Physics 1971

Dennis Gábor

… "for his invention and development of the holographic method"

Klaus von Klitzing

… "for the discovery of the quantized Hall effect"

Georg Bednorz, Karl Alexander Müller

… "for their important break-through in the discovery of superconductivity in ceramic materials"

NP 04: Nobel Prize in Physics 1989

Wolfgang Paul, Hans Georg Dehmelt

… "for the development of the ion trap technique"

Steven Chu, Claude Cohen-Tannoudji, William Daniel Phillips

…"for development of methods to cool and trap atoms with laser light."

NP 06: Nobel Prize in Physics 1998

Robert Betts Laughlin, Horst Ludwig Störmer, Daniel Chee Tsui

…"for their discovery of a new form of quantum fluid with fractionally charged excitations"



Eric Allin Cornell, Wolfgang Ketterle, Carl Edwin Wieman

…"for the achievement of Bose–Einstein condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates"

NP 08: Nobel Prize in Physics 2005

John Lewis Hall, Theodor Hänsch

…"for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique"

Albert Fert, Peter Grünberg

…"for the discovery of giant magnetoresistance"

NP 10: Nobel Prize in Physics 2010

Andre Geim, Konstantin Novoselov

…"for groundbreaking experiments regarding the two-dimensional material graphene"

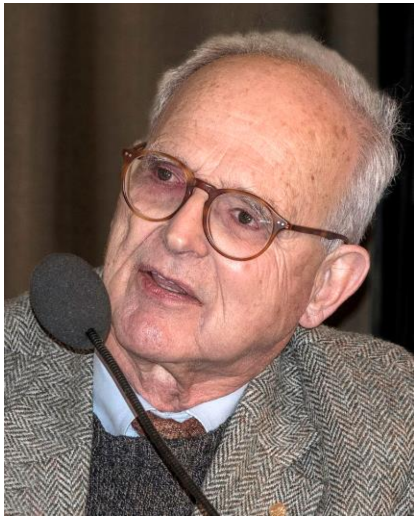
Isamu Akasaki, Hiroshi Amano, Shuji Nakamura

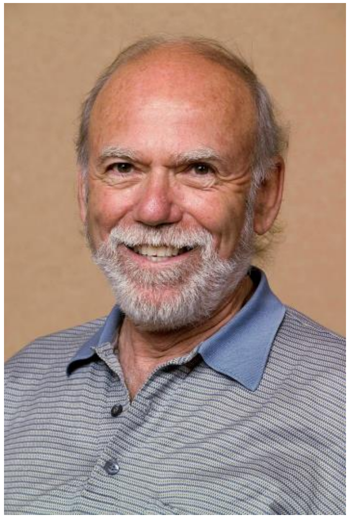
…"for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"

NP 12: Nobel Prize in Physics 2017

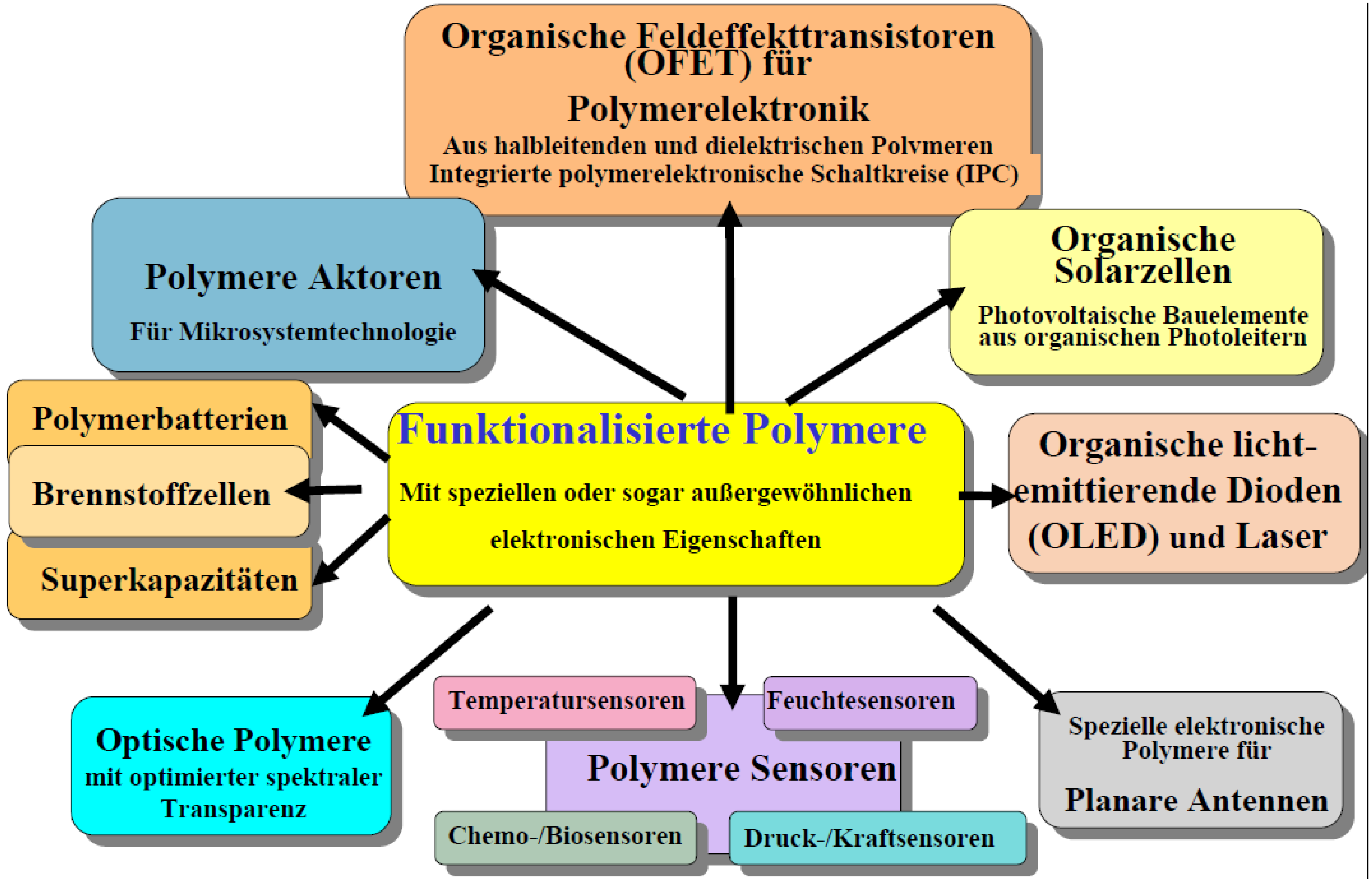
Rainer Weiss, Barry Barish, Kip Thorne

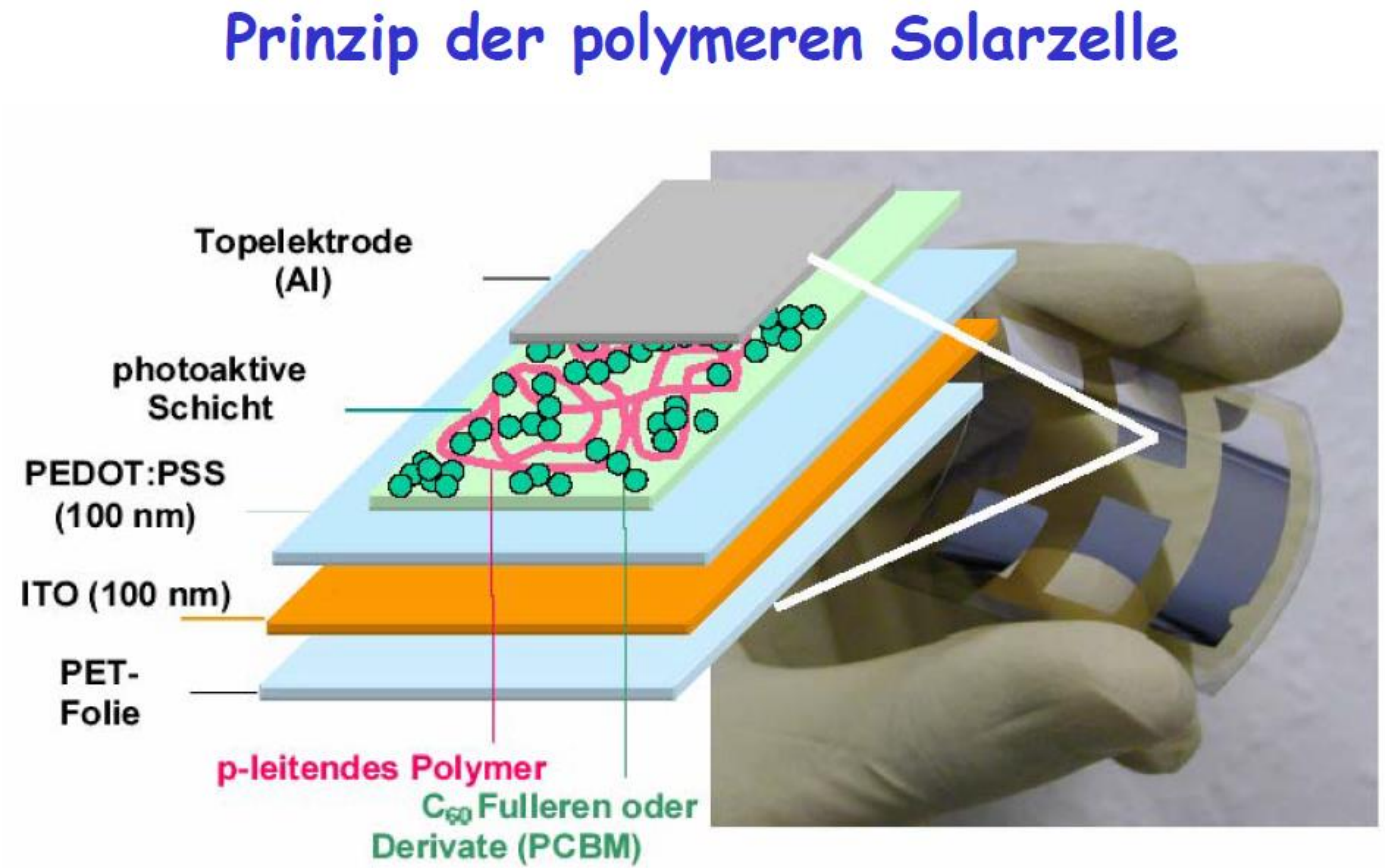
…"for decisive contributions to the LIGO detector and the observation of gravitational waves"





Basis for “organic” electronics

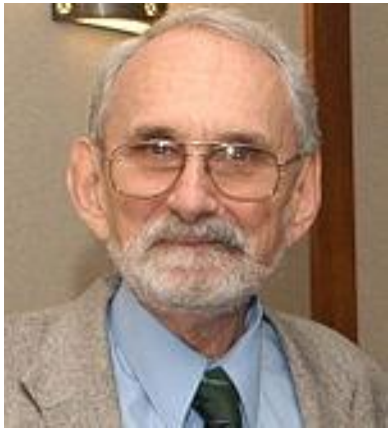


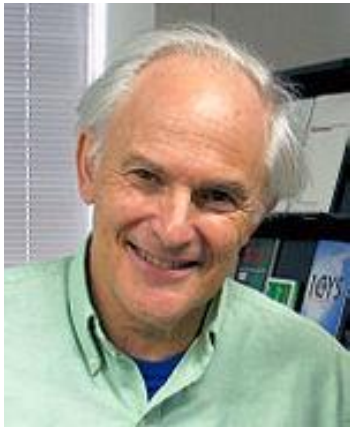

Prinzip der polymeren Solarzelle
Topelektrode
(Al)
photoaktive
Schicht
PEDOT:PSS
(100 nm)
ITO (100 nm)
PET-
Folie
p-leitendes Polymer
C60 Fulleren oder
Derivate (PCBM)

NP 15: Nobel Prize in Chemistry 1996

Robert F. Curl Jr., Sir Harold W. Kroto, Richard E. Smalley

…"for their discovery of fullerenes"

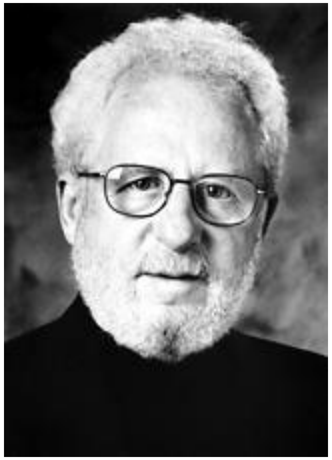




NP 16: Nobel Prize in Chemistry 2000

Alan J. Heeger, Alan G. MacDiarmid, Hideki Shirakawa

…"for their discovery and development of conductive polymers"



MOSFETs with Stacked 2D Nanosheet Channels – An Auspicious Option to Delay "Forever"

F. Schwierz[1], M. Ziegler[1], and J. J. Liou[2]

[1]Technische Universität Ilmenau, Germany, [2]North Minzu University, Yinchuan, China

- Introduction
- CMOS Scaling Trends and Moore's Law
- The Four Stages of CMOS Scaling
- MOSFETs with Stacked 2D Nanosheet Channels
- Conclusion

Nature | Vol 620 | 17 August 2023 | 501

Perspective

The future transistors

https://doi.org/10.1038/s41586-023-06145-x

Received: 19 August 2020

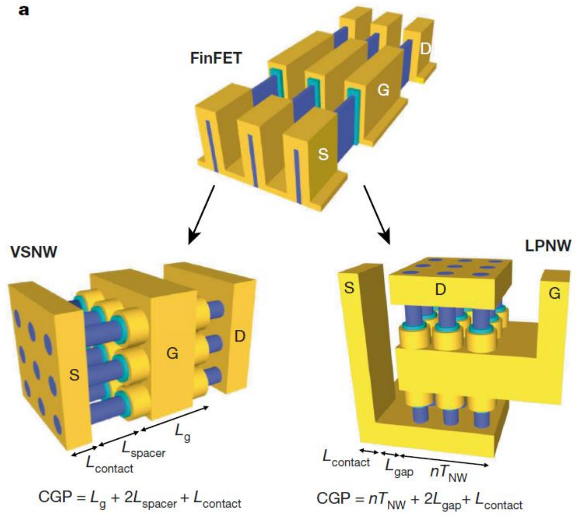
Accepted: 27 April 2023

Published online: 16 August 2023

Check for updates

Wei Cao[1], Huiming Bu[2], Maud Vinet[3], Min Cao[4], Shinichi Takagi[5], Sungwoo Hwang[6], Tahir Ghani[7] & Kaustav Banerjee[1]✉

The metal–oxide–semiconductor field-effect transistor (MOSFET), a core element of complementary metal–oxide–semiconductor (CMOS) technology, represents one of the most momentous inventions since the industrial revolution. Driven by the requirements for higher speed, energy efficiency and integration density of integrated-circuit products, in the past six decades the physical gate length of



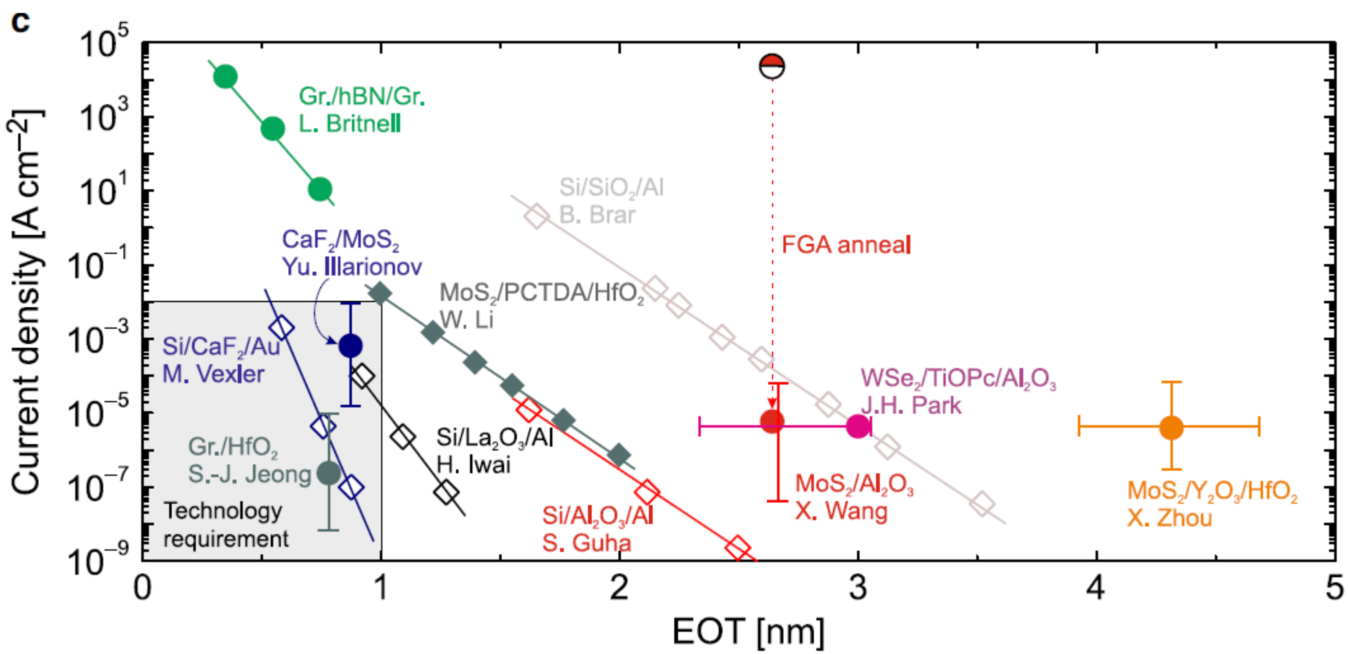
REVIEW ARTICLE

https://doi.org/10.1038/s41467-020-16640-8

OPEN

Insulators for 2D nanoelectronics: the gap to bridge

Yury Yu. Illarionov[1,2]✉, Theresia Knobloch[1], Markus Jech[1], Mario Lanza[3], Deji Akinwande[4], Mikhail I. Vexler[2], Thomas Mueller[5], Max C. Lemme[6,7], Gianluca Fiori[8], Frank Schwierz[9] & Tibor Grasser[1]✉



Molybdenum disulfide transistors with enlarged van der Waals gaps at their dielectric interface via oxygen accumulation

Received: 4 March 2022

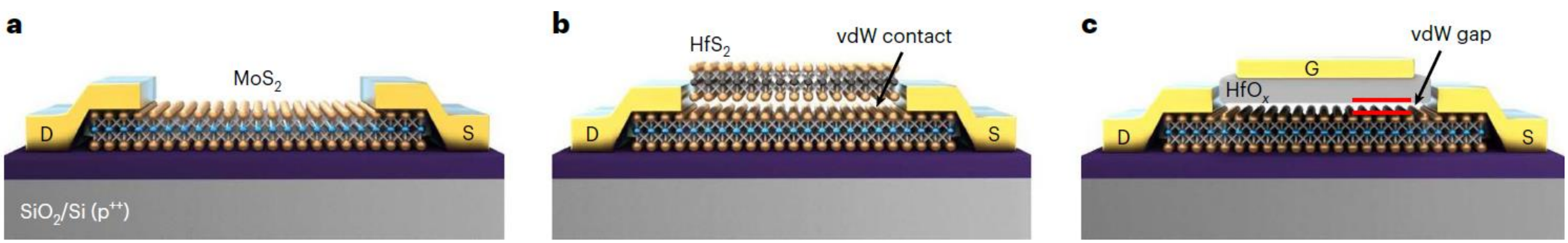
Accepted: 21 October 2022

Published online: 5 December 2022

Check for updates

Pengfei Luo[1,2], Chang Liu[1], Jun Lin[1], Xinpei Duan[1], Wujun Zhang[1], Chao Ma[1], Yawei Lv[1], Xuming Zou[1,2], Yuan Liu[1], Frank Schwierz[3], Wenjing Qin[1,4], Lei Liao[1,2], Jun He[5] & Xingqiang Liu[1,2,6]

Two-dimensional molybdenum disulfide (MoS_2) is a potential alternative channel material to silicon for future scaled transistors. Scaling down the gate dielectric and maintaining a high-quality interface is challenging with such materials, because the atomic thickness of MoS_2 makes it sensitive to defects common in amorphous gate oxides such as hafnium oxide (HfO_x).

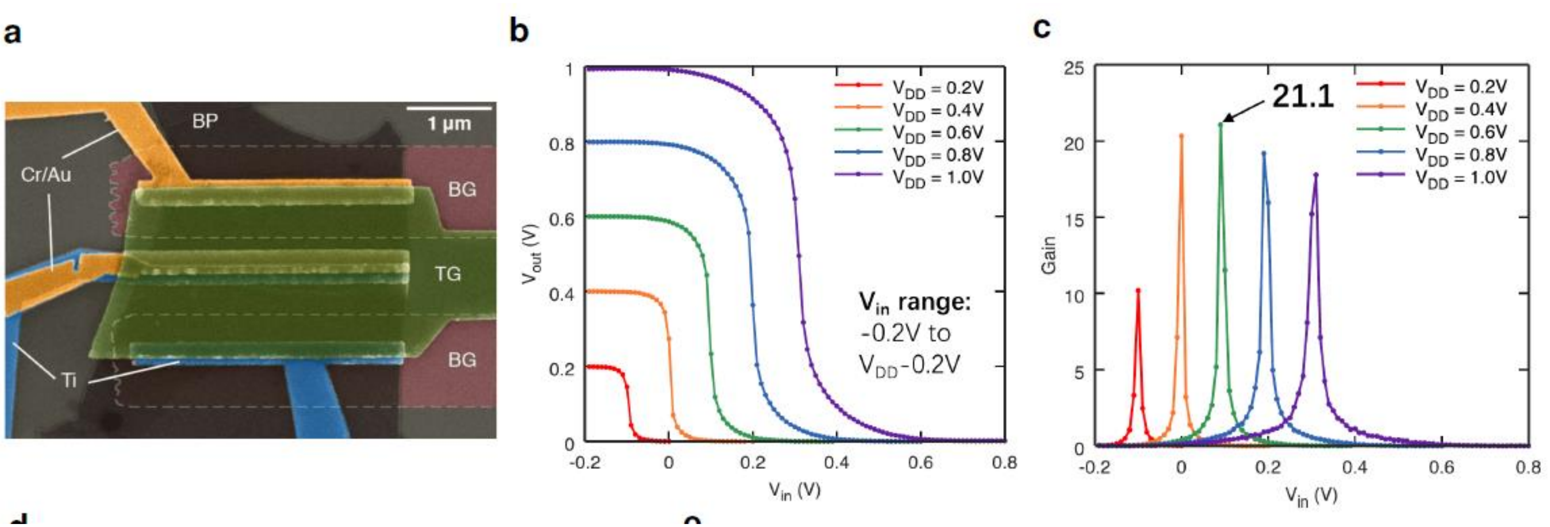


Review

Challenges for Nanoscale CMOS Logic Based on Two-Dimensional Materials

Theresia Knobloch *, Siegfried Selberherr and Tibor Grasser

Institute for Microelectronics, TU Wien, Gußhausstraße 27–29/E360, 1040 Vienna, Austria
* Correspondence: knobloch@iue.tuwien.ac.at



REVIEW

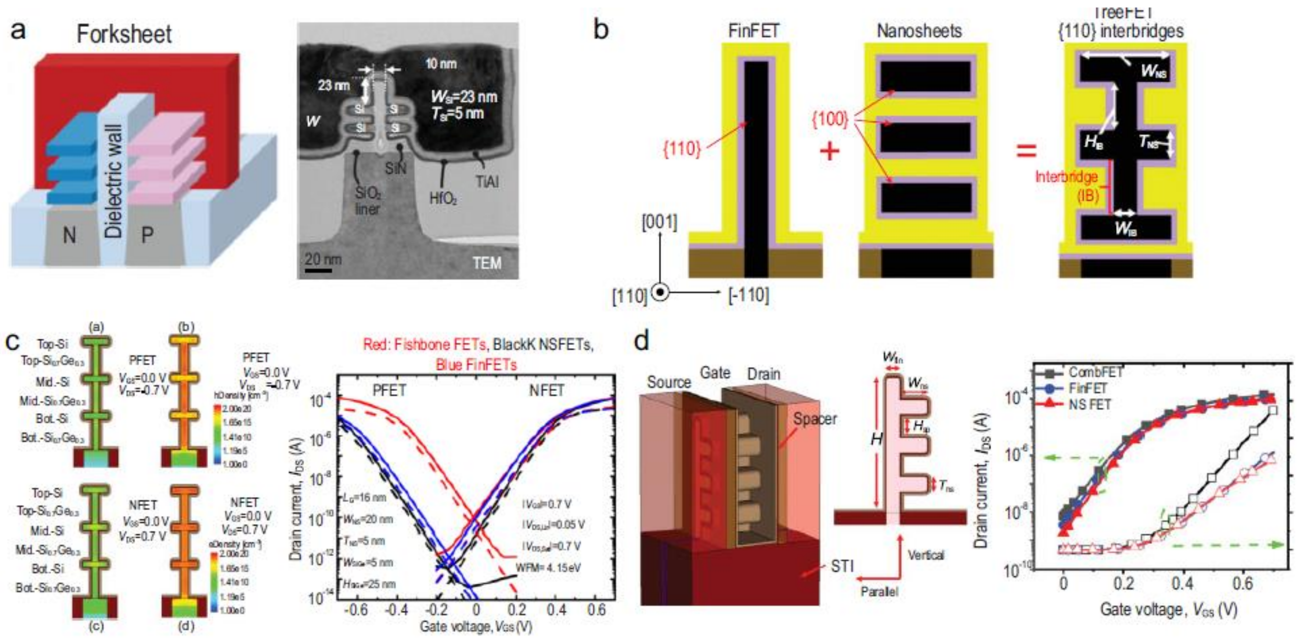
National Science Review
11: nwae008, 2024
https://doi.org/10.1093/nsr/nwae008
Advance access publication 5 January 2024

INFORMATION SCIENCE

Special Topic: Emerging Materials and Transistors for Integrated Circuits

New structure transistors for advanced technology node CMOS ICs

Qingzhu Zhang[1,2,†], Yongkui Zhang[1,2,†], Yanna Luo[1,3] and Huaxiang Yin[1,2,3,*]



J. Phys. D: Appl. Phys. **51** (2018) 273001 (13pp)

https://doi.org/10.1088/1361-6463/aac8aa

Topical Review

Gallium nitride vertical power devices on foreign substrates: a review and outlook

Yuhao Zhang[1], Armin Dadgar[2] and Tomás Palacios[1]

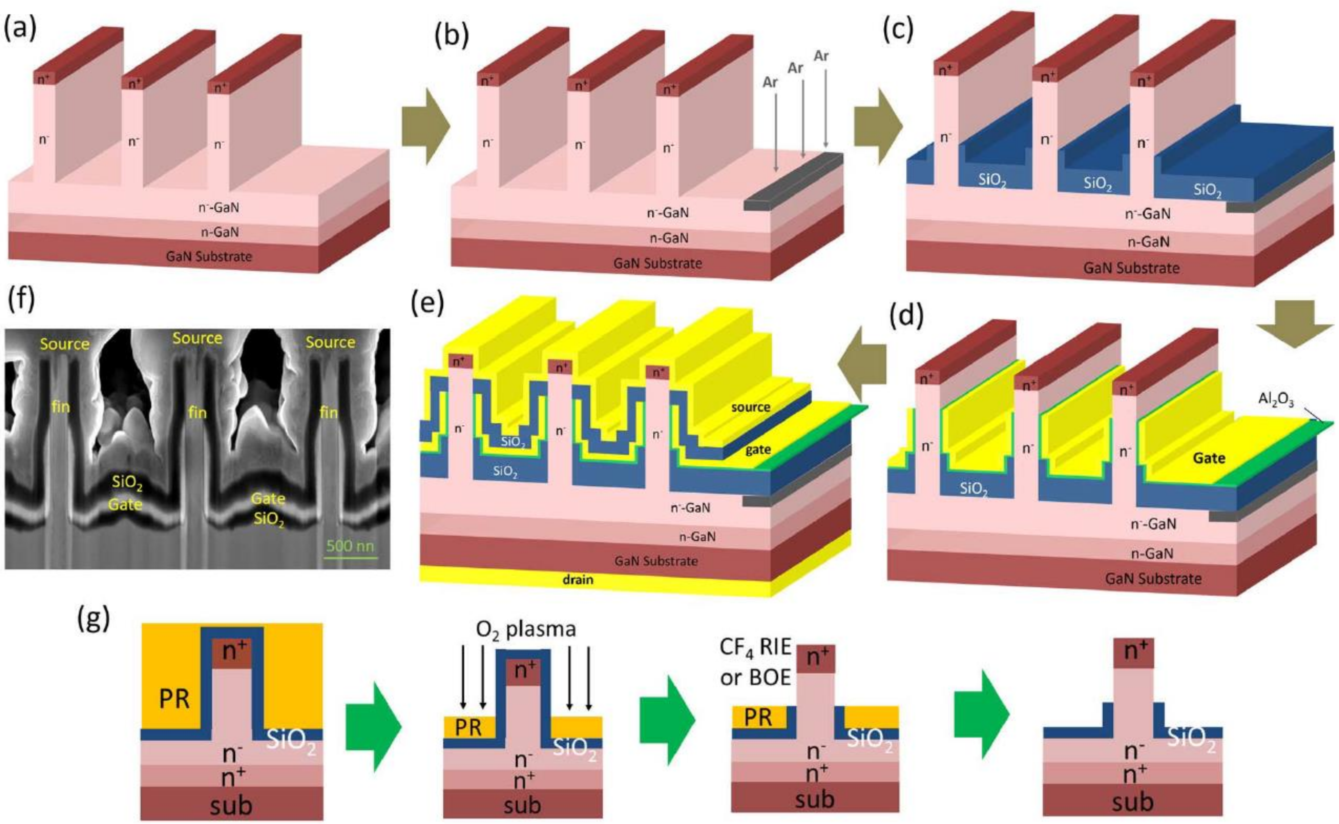
[1] Microsystems Technology Laboratories, Massachusetts Institute of Technology, Cambridge, MA 02139, United States of America
[2] Institute of Experimental Physics, Otto-von-Guericke-University Magdeburg, Magdeburg 39106, Germany

3960 IEEE TRANSACTIONS ON ELECTRON DEVICES, VOL. 67, NO. 10, OCTOBER 2020

(Ultra)Wide-Bandgap Vertical Power FinFETs

Yuhao Zhang, *Member, IEEE*, and Tomás Palacios, *Fellow, IEEE*

(Invited Paper)



GaN-based power devices: Physics, reliability, and perspectives FREE

Special Collection: Wide Bandgap Semiconductor Materials and Devices

Matteo Meneghini ; Carlo De Santi ; Idriss Abid; Matteo Buffolo ; Marcello Cioni; Riyaz Abdul Khadar ; Luca Nela ; Nicolò Zagni ; Alessandro Chini ; Farid Medjdoub ; Gaudenzio Meneghesso ; Giovanni Verzellesi ; Enrico Zanoni; Elison Matioli

Check for updates

J. Appl. Phys. 130, 181101 (2021)
https://doi.org/10.1063/5.0061354

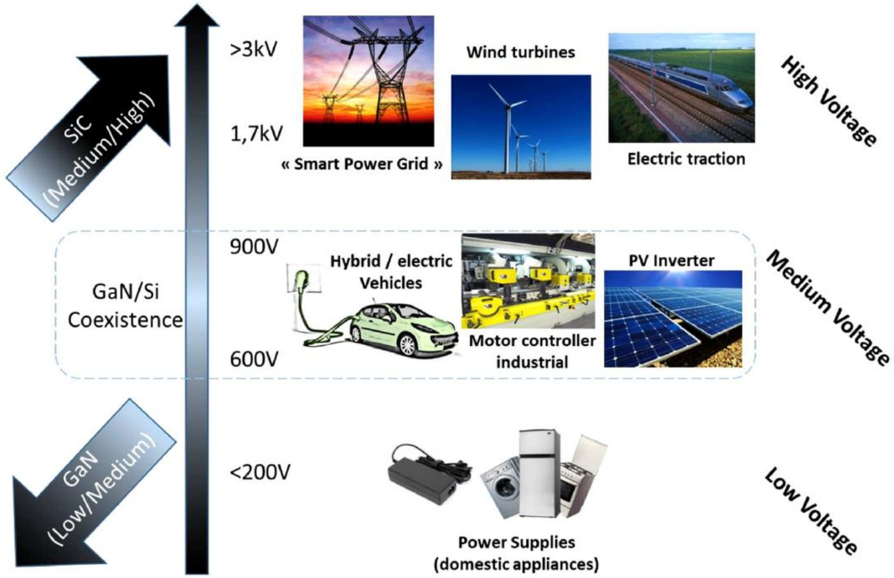


FIG. 14. Examples of applications using different voltage ranges.

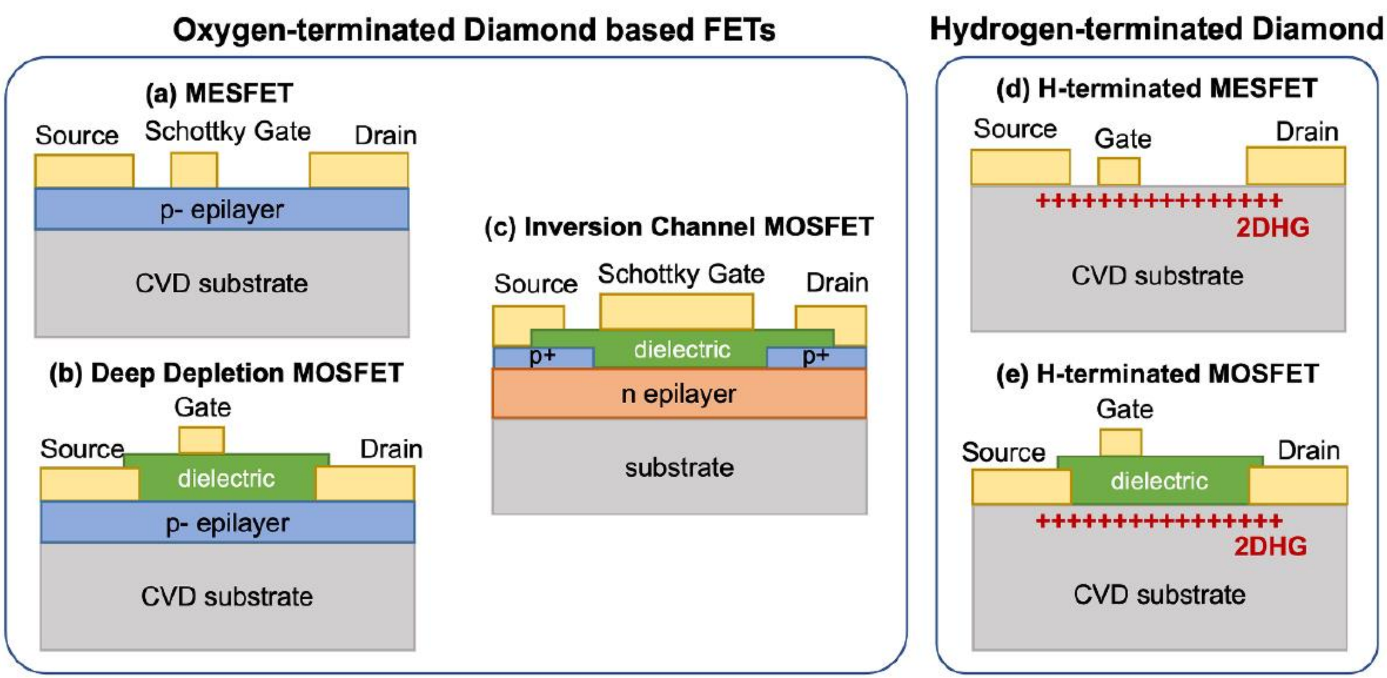
13: Power WBG   Diamond and other

Journal of Physics: Materials

TOPICAL REVIEW

From wide to ultrawide-bandgap semiconductors for high power and high frequency electronic devices

Kelly Woo[1,3], Zhengliang Bian[1,2,3], Maliha Noshin[1,3], Rafael Perez Martinez[1], Mohamadali Malakoutian[1], Bhawani Shankar[1] and Srabanti Chowdhury[1,*]

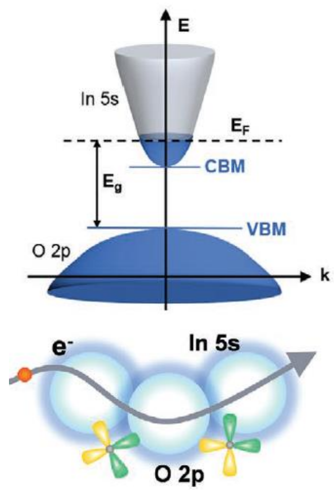


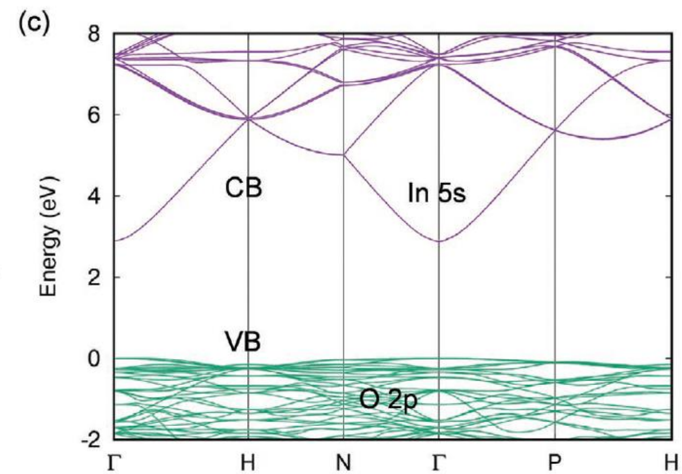
REVIEW

ADVANCED MATERIALS
www.advmat.de

Wide Bandgap Oxide Semiconductors: from Materials Physics to Optoelectronic Devices

*Jueli Shi, Jiaye Zhang, Lu Yang, Mei Qu, Dong-Chen Qi, and Kelvin H. L. Zhang**





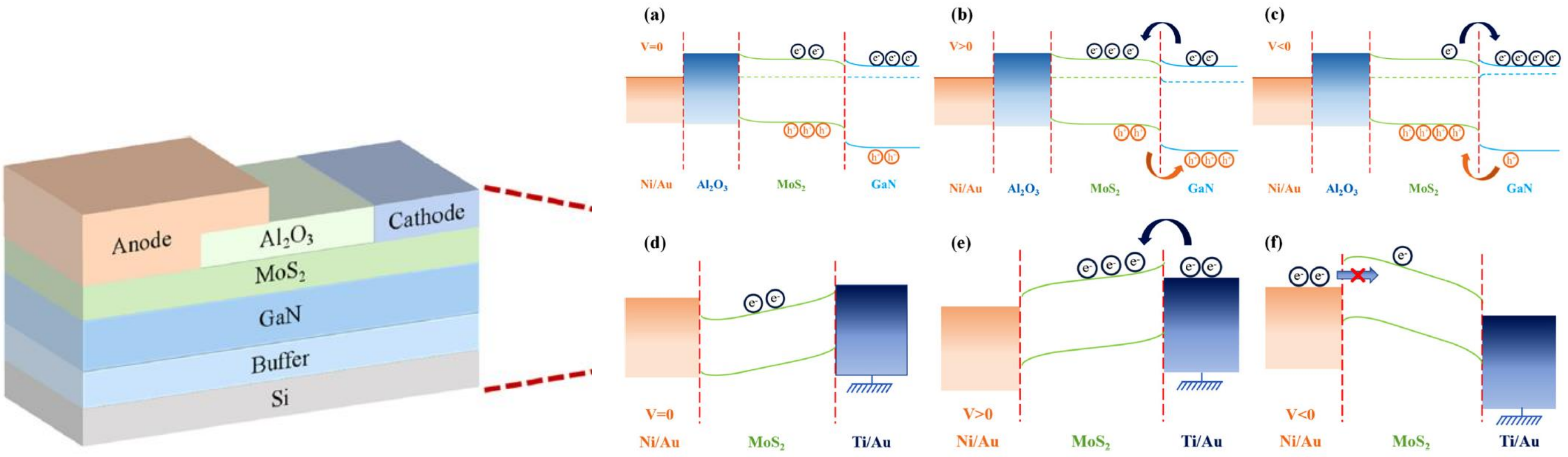
RESEARCH ARTICLE | SEPTEMBER 16 2024

MOS-structured MoS_2/GaN Schottky barrier diodes with high on/off current ratio and low threshold voltage

Special Collection: Critical Issues on the 2D-material-based field-effect transistors

Runjie Zhou ; Wenliang Wang ; Guoqiang Li

Appl. Phys. Lett. 125, 122103 (2024)
https://doi.org/10.1063/5.0231505



RESEARCH ARTICLE | SEPTEMBER 09 2024

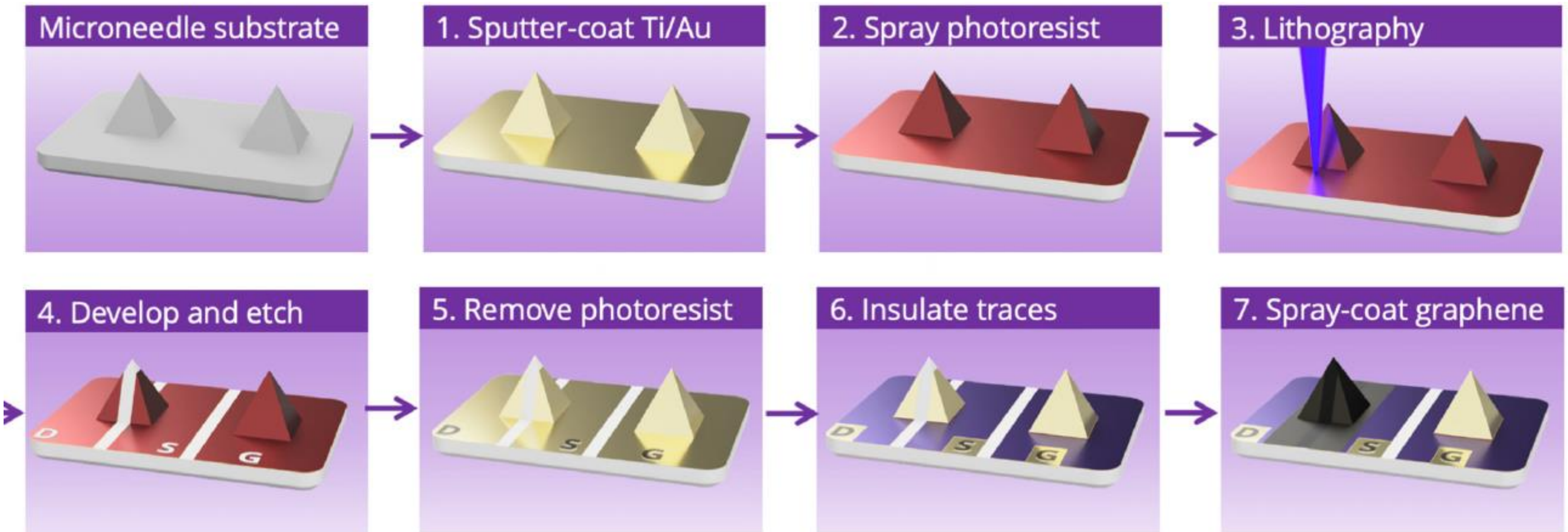
Fabrication of graphene field effect transistors on complex non-planar surfaces

Special Collection: Critical Issues on the 2D-material-based field-effect transistors

M. Holicky ; B. Fenech-Salerno ; A. E. G. Cass ; F. Torrisi

Check for updates

Appl. Phys. Lett. 125, 113301 (2024)
https://doi.org/10.1063/5.0226780



Roadmap on photonic metasurfaces

Cite as: Appl. Phys. Lett. **124**, 260701 (2024); doi: 10.1063/5.0204694
Submitted: 22 February 2024 · Accepted: 18 May 2024 ·
Published Online: 28 June 2024

View Online Export Citation CrossMark

Sebastian A. Schulz,[1,a)] Rupert. F. Oulton,[2,a)] Mitchell Kenney,[3,a)] Andrea Alù,[4,5] Isabelle Staude,[6] Ayesheh Bashiri,[6] Zlata Fedorova,[6] Radoslaw Kolkowski,[7] A. Femius Koenderink,[8] Xiaofei Xiao,[2] John Yang,[2] William J. Peveler,[9] Alasdair W. Clark,[10] George Perrakis,[11] Anna C. Tasolamprou,[12] Maria Kafesaki,[11,13] Anastasiia Zaleska,[14] Wayne Dickson,[14] David Richards,[14] Anatoly Zayats,[14] Haoran Ren,[15] Yuri Kivshar,[16] Stefan Maier,[15,17] Xianzhong Chen,[18] Muhammad Afnan Ansari,[18] Yuhui Gan,[19] Arseny Alexeev,[20] Thomas F. Krauss,[21] Andrea Di Falco,[19] Sylvain D. Gennaro,[22] Tomás Santiago-Cruz,[23] Igal Brener,[23] Maria V. Chekhova,[24] Ren-Min Ma,[25] Viola V. Vogler-Neuling,[26] Helena C. Weigand,[27] Ülle-Linda Talts,[27] Irene Occhiodori,[27] Rachel Grange,[27] Mohsen Rahmani,[28] Lei Xu,[28] S. M. Kamali,[29] E. Arababi,[30] Andrei Faraon,[31] Anthony C. Harwood,[2] Stefano Vezzoli,[2] Riccardo Sapienza,[2] Philippe Lalanne,[32] Alexandre Dmitriev,[33] Carsten Rockstuhl,[34,35] Alexander Sprafke,[36] Kevin Vynck,[37] Jeremy Upham,[38,39] M. Zahirul Alam,[38,39] Israel De Leon,[40,41] Robert W. Boyd,[38,39] Willie J. Padilla,[42] Jordan M. Malof,[43] Aloke Jana,[44] Zijin Yang,[45] Rémi Colom,[46] Qinghua Song,[45] Patrice Genevet,[44] Karim Achouri,[47] Andrey B. Evlyukhin,[48,49] Ulrich Lemmer,[50,51] and Ivan Fernandez-Corbaton[35]

nature reviews materials

https://doi.org/10.1038/s41578-023-00583-9

Review article

Check for updates

Low-dimensional wide-bandgap semiconductors for UV photodetectors

Ziqing Li[1,3], Tingting Yan[2,3] & Xiaosheng Fang[1,2]

41: Emerging metal oxides: Review

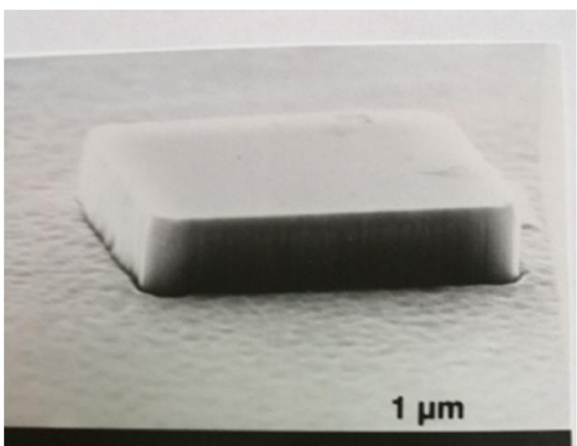
APPLIED PHYSICS REVIEWS **5**, 011301 (2018)

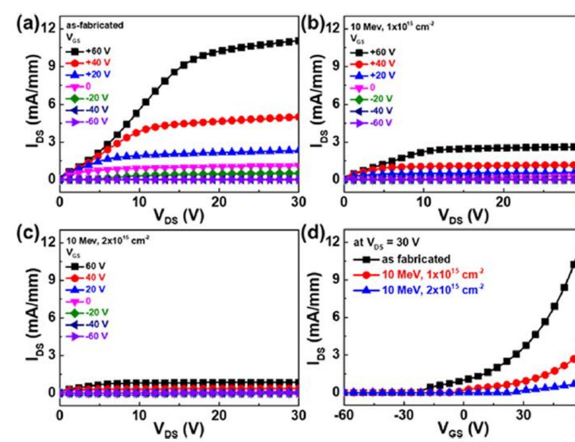
APPLIED PHYSICS REVIEWS

A review of Ga_2O_3 materials, processing, and devices

S. J. Pearton,[1,a)] Jiancheng Yang,[2] Patrick H. Cary IV,[2] F. Ren,[2] Jihyun Kim,[3,a)] Marko J. Tadjer,[4] and Michael A. Mastro[4]

[1]*Department of Materials Science and Engineering, University of Florida, Gainesville, Florida 32611, USA*
[2]*Department of Chemical Engineering, University of Florida, Gainesville, Florida 32611, USA*
[3]*Department of Chemical and Biological Engineering, Korea University, Seoul 02841, South Korea*
[4]*US Naval Research Laboratory, Washington, DC 20375, USA*



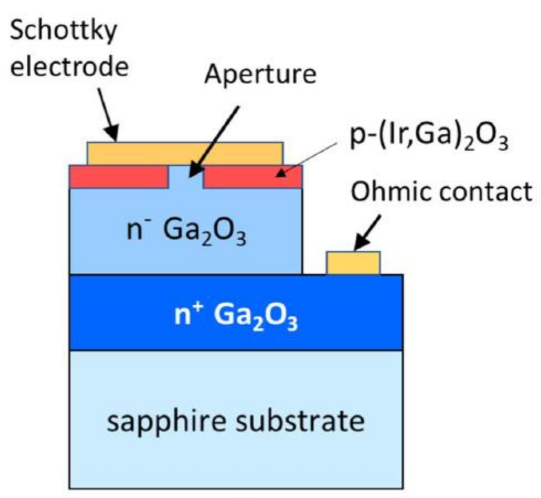


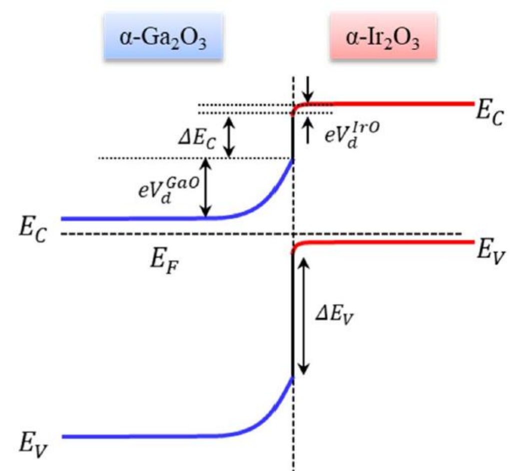
Japanese Journal of Applied Physics **62**, SF0803 (2023)
https://doi.org/10.35848/1347-4065/acd125

Progress in α-Ga_2O_3 for practical device applications

Kentaro Kaneko[1,2*], Shizuo Fujita[3], Takashi Shinohe[4], and Katsuhisa Tanaka[2]

[1]Research Organization of Science and Technology, Ritsumeikan University, Kusatsu, Shiga 525-8577, Japan
[2]Department of Material Chemistry, Kyoto University, Nishikyo-ku, Kyoto 615-8510, Japan
[3]Office of Society-Academia Collaboration for Innovation, Kyoto University, Sakyo-ku, Kyoto 606-8501, Japan
[4]FLOSFIA Inc., Nishikyo-ku, Kyoto 615-8245, Japan





43_a: Emerging metal oxides: Growth β-Ga2O3

OPEN ACCESS

Applied Physics Express **17**, 090101 (2024)

APEX REVIEW

https://doi.org/10.35848/1882-0786/ad6b73

Check for updates

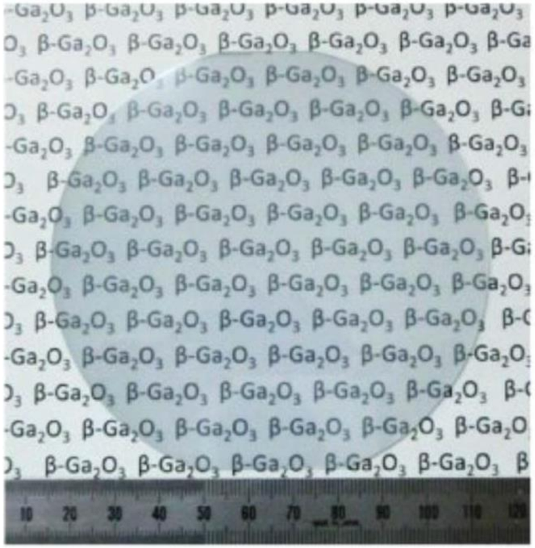
Prospects for β-Ga_2O_3: now and into the future

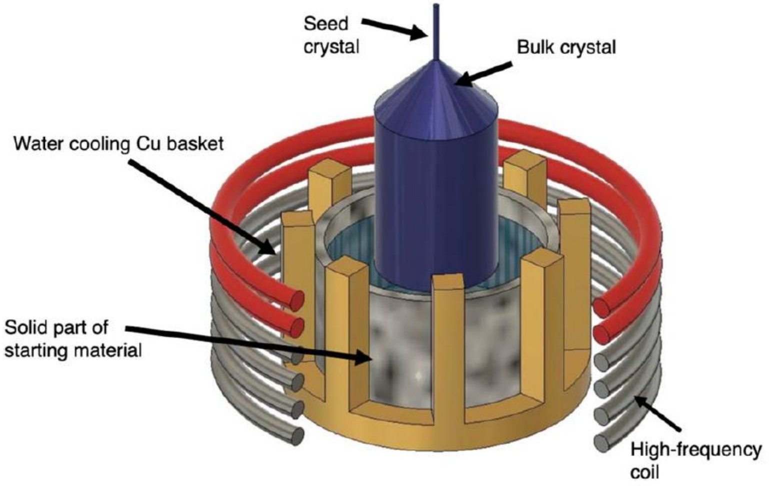
Kohei Sasaki

Novel Crystal Technology, Inc., Sayama, Saitama 350-1328, Japan

*E-mail: sasaki@novelcrystal.co.jp

Received July 24, 2024; revised August 2, 2024; accepted August 5, 2024; published online September 30, 2024





43_b: Emerging metal oxides: Electronic devices β-Ga2O3

OPEN ACCESS

Applied Physics Express **17**, 090101 (2024) **APEX REVIEW**

https://doi.org/10.35848/1882-0786/ad6b73

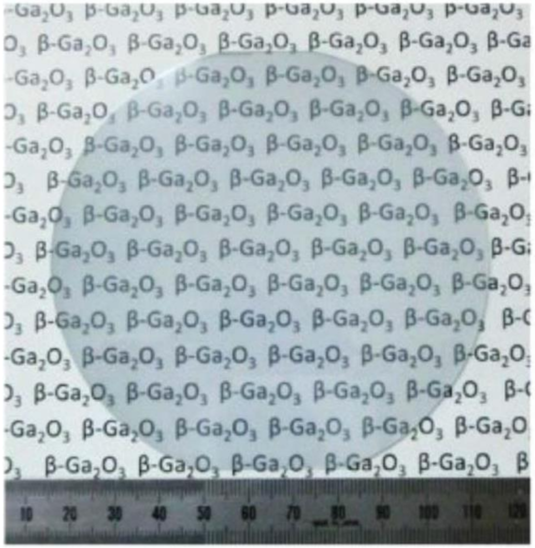
Prospects for β-Ga_2O_3: now and into the future

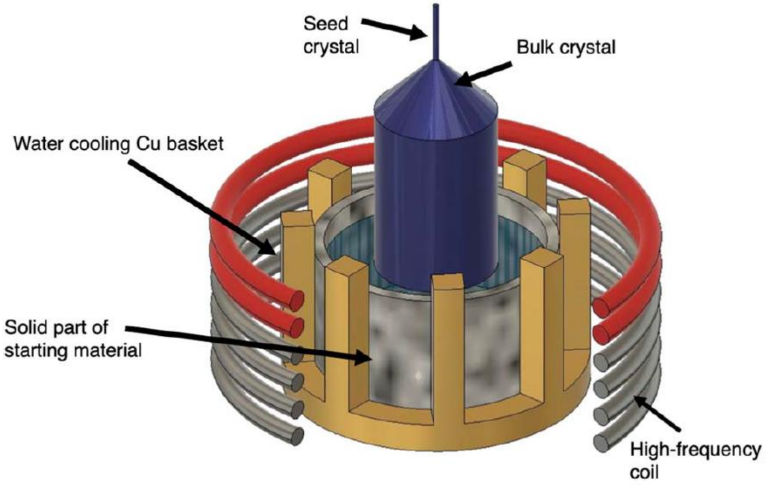
Kohei Sasaki

Novel Crystal Technology, Inc., Sayama, Saitama 350-1328, Japan

*E-mail: sasaki@novelcrystal.co.jp

Received July 24, 2024; revised August 2, 2024; accepted August 5, 2024; published online September 30, 2024





41: Emerging metal oxides: