Curriculum vitae

Prof. Dr. Ir. Gertjan Koster
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University of Twente, Enschede
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https://www.utwente.nl/tnw/ims/people/kosterg/
http://www-k9.ijs.si/about-us/external-consultants/prof-gertjan-koster

(1999) *Doctorate* University of Twente, Enschede, The Netherlands
Title Thesis: "*Artificially layered oxides by pulsed laser deposition*"
2019- *Full Professor* 'Physics of Inorganic nanomaterials', University of Twente.

Biography
In 1999 Prof. Dr. Ir. G. (Gertjan) Koster did his PhD on "Artificial layered complex oxides by pulsed laser deposition". In that same year, he moved to the US to join the Kapitulnik-Geballe-Beasley (KGB) group at the Geballe Laboratory for Advanced Materials, Stanford University. In 2007, he joined the Inorganic Materials Science group, MESA+ institute for nanotechnology, University of Twente, where since December 2019 he has been full professor. In 2014 he was a visiting professor at QMI-UBC in Vancouver and since 2018 he is a visiting professor of advanced materials department K9 at the Joseph Stephan Institute in Slovenia. His research focuses on the structure-property relation of atomically engineered complex (nano)materials, especially thin film ceramic oxides. For the thin film synthesis, he developed the first time-resolved RHEED-system, operating at high pressures up to 100 Pa during pulsed laser deposition. This work has led to a start-up company for which he is consultant and lecturer. Current research includes the growth and study of artificial materials, the physics of reduced scale (nanoscale) materials, metal-insulator transitions and in situ spectroscopic characterization. Application areas are functional materials for green ICT, neuromorphic computing, integration of oxides with CMOS, model systems for operando studies of oxide interfaces using X-ray spectroscopies or STEM-EELS (e.g., batteries, catalysis).

Other experience:

2018-	*Visiting professor, Advanced Materials Department K9, JSI*
(2018-2022)	*Jožef Stefan International Postgraduate School, Ljubljana*
(2014)	*Visiting professor QMI,* UBC, Vancouver.
(2007-2019)	*Adj./Assoc./Ass. professor (UHD/UD)*, Inorganic Materials Science, TNW, UT.
(1999-2007)	*Visiting scholar/Research associate*, *Lecturer, Lab director* Stanford University.
(1999)	*Post Doc*, Low Temperature Division, Dept. of Applied Physics, UT.

Activities:

- Co-Chair Inorganic Materials Science-TNW (2019-)
- Chair writing committee SEP evaluation TNW, UT (2023)
- Chair Nanoelectronic Materials (NEM) cluster TNW, UT (2020)
- Member NWO-ENW working groups 'Fundamentals& Methods of Chemistry' and 'Chemistry of materials'
- Management team 4TU.High Tech Materials (https://www.4tu.nl/htm/about-4TU-HTM/);
- Regional node NEMI (*Netherlands Electron Microscopy Infrastructure*)
- COST-action 'OPERA' MC Netherlands; evaluator STSM proposals.
- COST-action 'TO-BE' WG-2 leader (Thin films); MC Netherlands
- Referee (NWO, NSF, Nature, American Phys. Soc., American Chem. Soc., Elsevier, Wiley etc.)
- Organizer conferences (e.g., MRS, COST, Ameland workshop, QMI Workshop, Electroceramics, WOE)
- Chair and vice-chair Faculty council TNW, University of Twente (2010-2015)
- Consultant and lecturer Spin off companies Demcon-TSST and Lam Research-Solmates

Scholarships and prizes:
(2001) NWO TALENT stipend, (Netherlands Organization for Scientific Research; equiv. to Rubicon)
(2002) VENI scholarship, Netherlands Organization for Scientific Research NWO-STW
(2012) Educational prize 'Advanced Technology', University of Twente
(2019) Van Gogh Scholarship (Nuffic) exchange with CNRS Thales (Prof. Manuel Bibes)

recent significant publications:

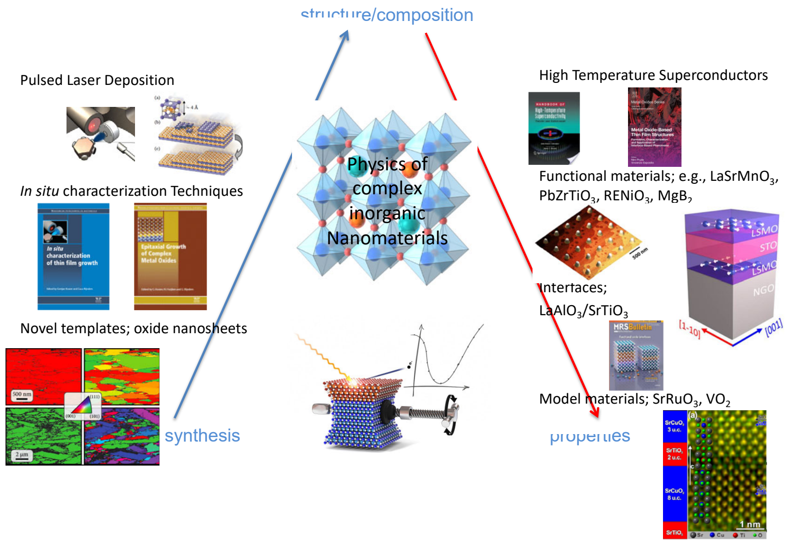
(2020) Strain-Engineered Metal-to-Insulator Transition and Orbital Polarization in Nickelate Superlattices Integrated on Silicon, Chen, BB (Chen, Binbin), .., Koster, G., **Advanced Materials**.

(2020) Tailoring Vanadium Dioxide Film Orientation Using Nanosheets: a Combined Microscopy, Diffraction, Transport, and Soft X-Ray in Transmission Study Le, PTP, …, Koster, G, **Adv. Functional Materials**

(2022) Enhancing the Energy-Storage Density and Breakdown Strength in PbZrO3/Pb0.9La0.1Zr0.52Ti0.48O3 Derived Antiferroelectric/Relaxor-Ferroelectric Multilayers, Minh Nguyen, … , Koster, G., … , Rijnders, G., **Adv. Energy Materials.**

(2022) Signatures of enhanced out-of-plane polarization in asymmetric BaTiO3 superlattices integrated on silicon Chen, BB (Chen, Binbin), , ... , Koster, G., **Nature Communications**.

Designing oxide materials for advanced materials experiments and novel applications.



Thin film oxides are studied with two main goals: 1) New experiments with the aim to reveal (novel) electronic or magnetic degrees of freedom in a condensed matter system often require ad hoc designed materials either to meet the conditions they're being interrogated at or match the used probes. 2) These very same materials systems (oxides) are expected to host a plethora of potentially technologically relevant properties, which further motivates their exploration in order to identify and demonstrate functionality.
Both goals can be achieved by having expertise in three areas: in situ spectroscopy of oxide thin films, the development of oxide thin film templates and the study of oxide thin film growth. Current focus application areas are: chemical sensors, brain inspired electronics and catalysis and energy conversion.

In situ Spectroscopy
In situ thin film (spectroscopic) characterization gives the opportunity to investigate intrinsic electronic properties of epitaxial systems by X-ray or electron spectroscopy as well as take advantage of different techniques for deposition, i.e., electron beam deposition and pulsed laser deposition. Because of the in situ-ness of the thin film synthesis, eliminating anomalies due to the interaction with ambient air, as well the fact that probing depth are of the order of the thin film thicknesses, a true comparison of electronic properties and transport properties are possible. Collaborations exist with UU, UBC/CLS, Soleil/Orsay, UvA/LCLS, PSI, Napels, DTU and EMAT, Antwerp.

- Current investigations, using the COMAT system at Twente, a UHV pulsed laser deposition (PLD) system with various in situ spectroscopies and imaging techniques (XPS, UPS, XPD, STM, AFM, PFM) inspired on the system above, are aimed at controlling the octahedra rotations by epitaxy and study their effect on properties of various magnetic perovskite-type oxides such as $SrRuO_3$ and $LaSrMnO_3$. Both in situ photoelectron spectroscopy as well in situ photoelectron diffraction are being employed and with an in situ nano-probe system based on scanning tunneling microscopy, transport measurements can simultaneously be performed on a local scale.

- In collaboration with the university of Amsterdam (Golden) a vacuum suitcase was developed, enabling us transport thin film samples under a ultra-high vacuum conditions to synchrotron facilities such as Bessy in Berlin and Diamond in the UK, where spectroscopic X-ray characterization has been performed (XAS, HAXPES, XPS etc.)

- Development and designing experiments dedicated to obtain high temporal and spatial resolution information of the electronic and magnetic structure of thin films. Among others by using X-ray or E-beam transparent thin film samples (collaborations with UU, UvA and EMAT, Antwerp).

- In a separate effort, in the MURI program for superconductor coated conductors a real time diagnostic tool was demonstrated, based on Fourier Transform Infrared reflectometry (appeared in Applied Physics Letters, 2007).

Oxide thin film templates

- *Atomic termination control of single crystal surfaces*
  The precise chemical nature of the terminating crystal plane of a substrate crystal has profound impact on the nucleation and growth of oxide thin films. The group has vast experience in developing recipes to achieve 100% pure unique termination
- *Pulsed laser deposition on 2D nanosheets*
  2-dimensional metal oxide nanosheets of Ti0.87O2 and Ca2Nb3O10 were used as 2D templates for guided growth of functional oxide films such as SrRuO3 (Nijland, *ACS Appl. Mater. Interfaces* **2013**) and (La,Sr)MnO3. Nanosheet films were synthesized and placed on silicon substrates by Langmuir-Blodgett deposition. Using pulsed laser deposition, SrRuO3 films were formed on the substrates containing the nanosheets seed layers. This promising possibility may pave the way to films with position dependent properties that are determined by the local crystallographic orientation (Nijland et al., Adv. Func. Mat. 2015). We obtained atomic scale roughness by introducing a SrTiO3 interlayer. Currently the properties of these films are studied.
- Development of buffer layers for technical substrates such as Si and GaN, collaboration with Josef Stefan Institute (Slovenia).

Oxide thin film Growth

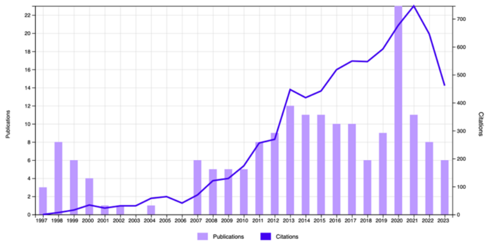
- Co-development of a high-pressure reflection high-energy energy diffraction (RHEED) to study the growth of complex oxides during pulsed laser deposition (PLD). This new technique allowed the *in situ* study of oxide thin film growth at the most favorable deposition conditions, that is high temperature to enable epitaxial growth and high deposition oxygen pressure to enable stable phase formation. As a direct result of this development, many new technologies have been developed.

- Hybrid Pulsed Laser Deposition/Molecular Beam Synthesis (MBE) system for oxide growth with *in situ* XPS[1], UPS[2] and RHEED[3]. Unlike PLD, MBE growth requires rate control for the individual components of the materials (e.g., Sr and Ru and O in $SrRuO_3$). The use of Electron Impact Emission Spectrometry was studied for such purposes as well as the generation of atomic oxygen.

- Epitaxially stabilized oxides with imposed crystal symmetries, such as CuO, which occurs as the monoclinic mineral tenorite in nature, but we have evidence now that CuO can assume higher crystal symmetry when grown on a suitable substrate.

- In situ monitoring of the transient PLD plasma plume composition and chemical conversions in relation to the film growth (APL materials 2016/2017).

Highlights Research output

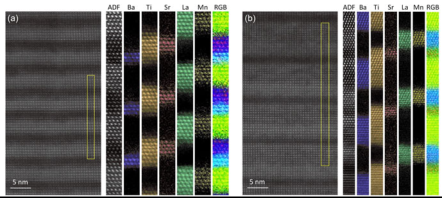
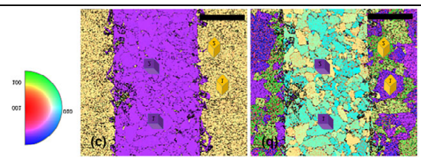
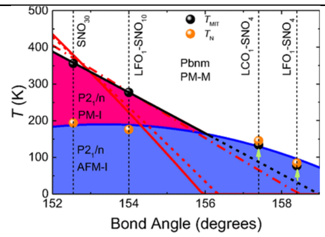


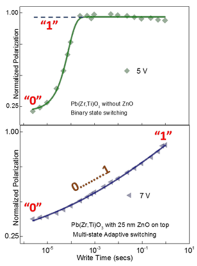
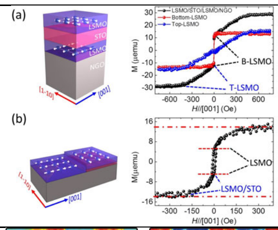
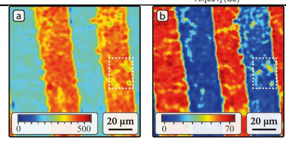
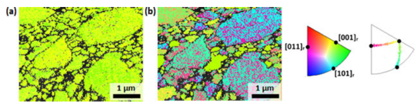
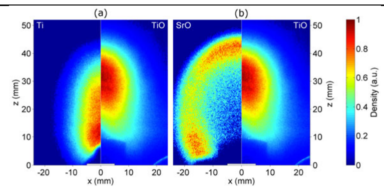
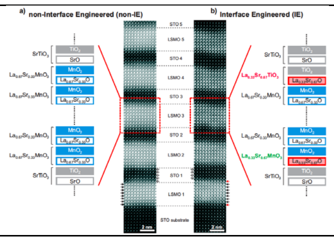
dd. 14-12-2020
Total publications 129, h-index 33

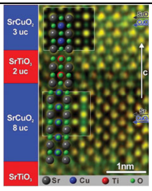
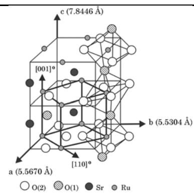
dd. 13-11-2023
Total publications 179, h-index 41

https://people.utwente.nl/g.koster
https://research.utwente.nl/en/persons/gertjan-koster

Highlights publications:

(2022), BB (Chen, Binbin), , ... , Koster, G., **Nature Communications**.	coll. ETH Zurich, EMAT Antwerp, IJS Ljubljana, IBM Zurich 
(2022), Minh Nguyen, ... , Koster, G., ... , Rijnders, G., **Adv. Energy Materials**.	
(2020) Chen, BB (Chen, Binbin), .., Koster, G., **Advanced Material**s.	coll. ETH Zurich, EMAT Antwerp, IJS Ljubljana, IBM Zurich
(2020) Le, PTP, .. , Koster, G, **Adv. Functional Materials**	 coll. EMAT Antwerp, Golden group UvA
Z. Liao, (2018) **PNAS**, 2018 115 (38) 9515-9520;	 Coll. EMAT, Antwerp; VanderWaals, Amsterdam; QMI, UBC, Vancouver, Univ. Liege; Unite Mixed, Thales, Paris
Liao, Z (2017) ***Advanced functional materials***.	Coll. EMAT, Antwerp; QMI, UBC, Vancouver;

Ghosh, A. et al. (2017) ***Advanced functional materials***, 26 (31). 5748 - 5756. ISSN 1616-301X	
Liao, Z. et al. (2016) ***Advanced functional materials***, 26. 6627 - 6634.	
Liao, Z. et al. ***Nature materials***, 15. 425 - 431. ISSN 1476-1122	
Nijland, M. et al. ***Advanced functional materials***, 25 (32). 5140 - 5148. ISSN 1616-301X	
Chen, Yunzhong ***Nature materials***, 14 . 801 - 806. ISSN 1476-1122	Coll. DTU, Denmark
Dral, A.P., et al. ***APL materials***, 3 . 056102 -. ISSN 2166-532X	
Groenen, Rik et al. ***APL materials***, 3 (7). 070701. ISSN 2166-532X	
Huijben, M. et al. ***Advanced materials interfaces***, 2 (3). ISSN 2196-7350	
Huijben, M. and Koster, G. et al. ***Advanced functional materials***, 23 (42). 5240 - 5248. ISSN 1616-301X	

Samal, D. et al. ***Physical review letters***, 111 (9). 096102. ISSN 0031-9007	
Siemons et al. **Physical Review Letters** (2007)	>500 citations
Koster, G. et al. ***Reviews of modern physics***, 84 (1). 253 - 298. ISSN 0034-6861	
Koster et al, **Applied Physics Letters** (1998)	>500 citations

<u>Upcoming and Recent Talks and Tutorials:</u>

(invited) MRS Spring meeting, Seattle (2024)
(popular) 'Show Some Science' in Ahoy, Rotterdam (2024)
(seminar) VO_2 research in Twente, NTT, Japan (2023)
(oratie) Dunne laagjes uit Twente, Enschede (2023)
(popular) Zwarte Cross, Universitent, Lichtenvoorde, NL (2023)
(popular) Manana-manana, Lochem, NL (2023)
(lecturer) Webinars and Trainings DEMCON-TSST (2020-2023)
(invited) 3rd Materials Science EM meeting, NEMI (2022)
(oral) E-EMRS Strasbourg (2022)
(Invited) MRS Fall meeting, Boston (2022)
(Invited) Success workshop, Les Houches, France, (2022)
(Invited) Quorom-1, Thales, Paris (2020)
(Invited) MRS Spring meeting (2020)
(Invited) Workshop on (S)TEM, Groningen, 19^{th} September (2019)
(Invited) TCO2019, Leipzig (2019)
(Popular) Zwarte Cross, Universitent, Lichtenvoorde, NL (2019)
(Invited) 4th Functional Oxide Thin Films for Adv. Energy and Inf. Technology Conf., Portugal (2019)
(Invited) EMRS Fall meeting, Warsaw, Poland (2018)
(Popular) Zwarte Cross, Universitent, Lichtenvoorde, NL (2018)
(Seminar) USTC /NSRL, Hefei, China (2018)
(Invited) JSPS Core-to-Core Japan Workshop, Tokyo, Japan (2018)
(Invited) 14th International Ceramics Congress, Perugia, Italy (2018)
(Invited) COST TO-BE Spring meeting, San Feliu, Spain (2018)
(lecturer) International Workshop 'Functionality of Oxide Interfaces', Germany (2018)

Grants and projects (Co) PI or project supervisor/work package leader (*PI on application)	**Position** (connected to Koster)	**year of award, name (20xx**: finished**)**	**Title**
Intel icw PSI*	1 PD	2023	COFEEE
Infinion*	1 PD	2023	SiC by Pulsed Laser Deposition
ENW-M2* (icw ARCNL)	1 PhD	2023	Ultrax
Groeifonds PhotonDelta	2 PhD	2023	BaTiO3
NWA-ORC	1 PhD	2023	NL-ECO
NWA-ORC	1 PhD	2022	Observed
PITC	1 PhD	2022	SiN photonics
KDT-HORIZON2020	1 PhD	2022	Listen2future
Groeifonds NExtGenHighTech Solmates	1 PhD	2022	Silicon-1
DIFFER-MESA+	1 PD	2021	PLD for energy materials
NWO Groot	NA	2021	HAXPES instrument
TKI-Chemie*	1 PhD	2021	Chemie-PGT
TKI-HTSM VDL-ETG	1 PhD	2020	Superconducting Actuators
ITN, Horizon2020	1 PhD	2020	MANIC
MESA+-Waterloo seed fund*	1 PD	2020	Laser based Nanosheet synthesis
NWO-TTW	1 PhD	2019 Moritz Nunnenkamp	EX3VAGAND: Energy Efficient Electron GaN Devices
NWA route Materialen	1 PhD	Yorick Birkhölzer 2018	NWA Green ICT
M-ERA.net*	1 PostDoc	2017 Binbin Chen	Engineering of silicon-oxide interface using the pulsed-laser deposition technique (SIOX)
EU H2020-ICT-2016-2017	1 PostDoc	Ufuk Halisdemir 2017	Ultra-Low Power Event-Based Camera (ULPEC)
FOM-IPP	1 PhD	2016 Huang	Fundamental Fluid Dynamics Challenges in Inkjet Printing (FIP)
NWO TOP-PUNT	1 PostDoc	2016 Laura Bégon-Lours	Searching for the "Silicon" of Piezoelectrics: Morphotropic Quartz (TOP PUNT)
	1 PhD	2016 Kit de Hond	
NWO ECHO*	1 PhD	2016 Phu Le	Getting oxide nanosheets in line: towards epitaxial substrates
STW FLOW+	1 PhD	2016 Shu Ni	PiezoMEMS for FLOW+
HTM Call 2015	1 PhD	2016 Thanh Do	Piezoelectric thin films for efficient, high-endurance, stable actuators for high-end ink-jet printing applications (Piezo4inkjet)
COST TO-BE **Work package leader**	NA	2014	
FOM-DESCO **(project coordinator)**	1 PhD	2014 Jaap Geessinck	Realization, nano structuring, and characterization of oxide 2DEG structures and devices
FOM HTSM	1 PostDoc	2013 Minh Nguyen	Moving chips: experimental piezofilms make silicon move for future inkjet printheads
	2 PhD	2013 David Dubbink	
		2014 Jun Wang	
NanoNext-7B Nanomaterials*	1 PhD	2010 Anirban Ghosh 2011 Lin Li	Multilayered and artificial materials
	1 PostDoc		
EOARD-RTS*	1 PostDoc	2010 Debakanta Samal	Room temperature superconductivity
STW	1 PhD	2010 Rik Groenen	Large-area pulsed laser deposition of thin films with atomic precision
CW-TOP*	2 PhD	2009 Bouwe Kuiper 2009 Maarten Nijland	Self-assembled oxidic mesostructures

FOM-M2i*	1 PhD	2009 Brian Smith	Dimensional cross-over physics of nano-scale object of ferroelectric oxides
FOM-M2i	1 PhD	2009 Nirupam Banerjee	PiezoNEMS: Nano-electrochemical systems with piezoelectric actuation

Press, Popular & Background:

(2022) https://www.utwente.nl/en/tnw/ims/news/2022/1/374264/ferroelectric-batio3-kept-in-order

(2021) https://www.nwo.nl/en/researchprogrammes/nwo-investment-grant-large/grants

(2021) https://www.utwente.nl/nieuws/2021/5/1065882/verborgen-materialen-bekijken-voor-groenere-accus-en-waterstof

(2016) https://www.utwente.nl/nieuws/!/2016/3/477452/nanotechnologen-ut-maken-richting-van-magnetisme-instelbaar-in-nieuwe-materialen

(2016) https://www.scientias.nl/nieuw-materiaal-laat-computer-denken-als-mens/

(2016) https://www.utwente.nl/nieuws/!/2016/7/180869/brein-inspireert-ut-onderzoekers-tot-nieuw-geheugenmateriaal

(2016) http://www.qaqs.org/nieuw/wp-content/uploads/2015/09/Uitn_160627h_GertjanKoster.pdf

(2014) http://www.utnieuws.nl/english/60662/Nobel_Prizes_explained

(2014) http://phys.org/news/2014-10-nanostructures-simple.html

(2014) http://www.nwo.nl/actueel/nieuws/2014/cw/nanostructuren-stempelen.html

(2014) *http://www.utwente.nl/nieuwsevents/2014/9/216804/nanostructuren-stempelen*

http://www.utwente.nl/en/newsevents/!/2014/9/216804/creating-nanostructures-using-simple-stamps

(2013) http://www.utwente.nl/mesaplus/nl/archief/2013/07/28-juli-publieksdag-bridges-2013.docx/

(2013) http://www.utwente.nl/archief/2013/07/wetenschap-ook-populair-op-zwarte-cross.docx

(2013) http://www.utwente.nl/mesaplus/nl/archief/2013/06/nanotechnologen-vinden-manier-om-defecten-in-materialen-terug-te-dringen.docx/

(2012) Een portret van de werkgroep QAQS (schoonheid), Gertjan Koster (http://www.quaartquascience.nl/agenda/)

(2012) http://www.kennislink.nl/publicaties/atomair-lego-levert-bijzonder-magnetisme

(2012) Room-temperature magnetism in insulating thin films, http://www.utwente.nl/tnw/ims/news/23okt12_LSMO110%5B2%5D.docx/

(2011) Unexpected heterostructure seen in STO (http://nanotechweb.org/cws/article/tech/47039)

(2011) Nobel lezing TNW 2011; http://www.utwente.nl/evenementen/nobel-lezingen-2011

(2011) http://www.telegraaf.nl/buitenland/10674247/__Inzicht_in_materie_veranderd__.html

(2010) *Koolstof in de ruimte en tijd; een wetenschappelijke zoektocht*, Gertjan Koster, Josée Kleibeuker in *Het fenomeen van Schaal*, Qua art Qua Science November 2010 (http://www.quaartquascience.nl/fileadmin/user_upload/documents/Uitgaven/Nov_2010_NANO.pdf)

(2009) *Every single layer matters*, Alex Klironomos, Physics Synopsys (http://physics.aps.org/synopsis-for/10.1103/PhysRevB.79.140407); Editors Choice Phys. Rev. B (http://prb.aps.org/edannounce/PhysRevB.77.130001)

(2009) *How to make CuO sit up straight*, Jessica Thomas, Physics Synopsys (http://physics.aps.org/synopsis-for/10.1103/PhysRevB.79.195122); Editors Choice Phys. Rev. B (http://prb.aps.org/edannounce/PhysRevB.77.130001)

(2009) 2 *artikelen vakgroep IMS binnen korte tijd geselecteerd als 'Editors' Suggestion'*, (http://www.tnw.utwente.nl/nieuws/nieuws/archief/2009/2009_06_04/2_artikelen_vakgroep_ims_geselecteerd.doc/)

(2009) Innovatief chemisch onderzoek UT beloond, (http://www.tnw.utwente.nl/nieuws/nieuws/archief/2009/2009_06_18/innovatief_chemisch_onderzoek.doc/)

(2008) *Kunstkristalbouwer nummer drie* by Henk Klomp, Technisch Weekblad no. 9 (in dutch); COMAT system

(2007) *Monitoring-and Possibly Improving-Superconducting Films* by Hang Hogan, Spectroscopy Focus, September, pg 107; on APL 90 (2007) 261917

(2007) *Watch out for the lack of oxygen* by James N. Eckstein, Nature Materials (News and Views), **6** 473; PRL 98 (2007) 196802

(2007) *Evidence suggests that a ferromagnetic metal may lie at the interface between nonmagnetic insulators* by B.G. Levi, Physics Today, June; PRL 98 (2007) 196802