Innovation in PV through industrial and international collaboration

Innovation en PV grâce à la collaboration industrielle et internationale

Gerhard Gobsch, Stefan Krischok
TU Ilmenau, Institut für Physik
Mohamed Bouafia
Université Sétif 1

Colloque International

La Créativité des Territoires,
Enjeu des Formations Durables

Novembre 05 - 06, 2017

Technische Universität Ilmenau

Synopsis

→ Pofile of TU Ilmenau
→ Innovation in PV through industrial and international collaboration

Example: Photovoltaics

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Departments

- Department of Computer Science and Automation
- Department of Economic Sciences and Media
- Department of Electrical Engineering and Information Technology
- Department of Mathematics and Natural Sciences
- Department of Mechanical Engineering

- 6 Inter-departmental Institutes, e.g. Institute of Micro- and Nanotechnologies (IMN)
- Competency Center for Nanopositioning and Nanomeasuring Machines

Technische Universität Ilmenau

Staff

- Professors
  - University Professors 102
  - endowed Professorships (Professeurs titulaires) 10
  - junior professorships 8
- academic staff (budget financed) 400
- Third party-financed staff (financé par un tiers) 400

- All students (in winter term 2016/17) 6248
  - Students from abroad ~20%
  - Female students ~28%

Stand: 11/2017

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Bachelor‘s (19) and Master‘s degree programs (25) in

Engineering Sciences (17)
Mathematics and Natural Sciences (7)
Business and Social Sciences (5)

Double master courses in:

Biomedical engineering,
Electrical engineering,
Informatics,
Information technology,
Automotive Engineering,
Mechatronics, Micromechanics,
Material sciences

(together with Universities in China, France, Malaysia, Peru, Romania, Russia)

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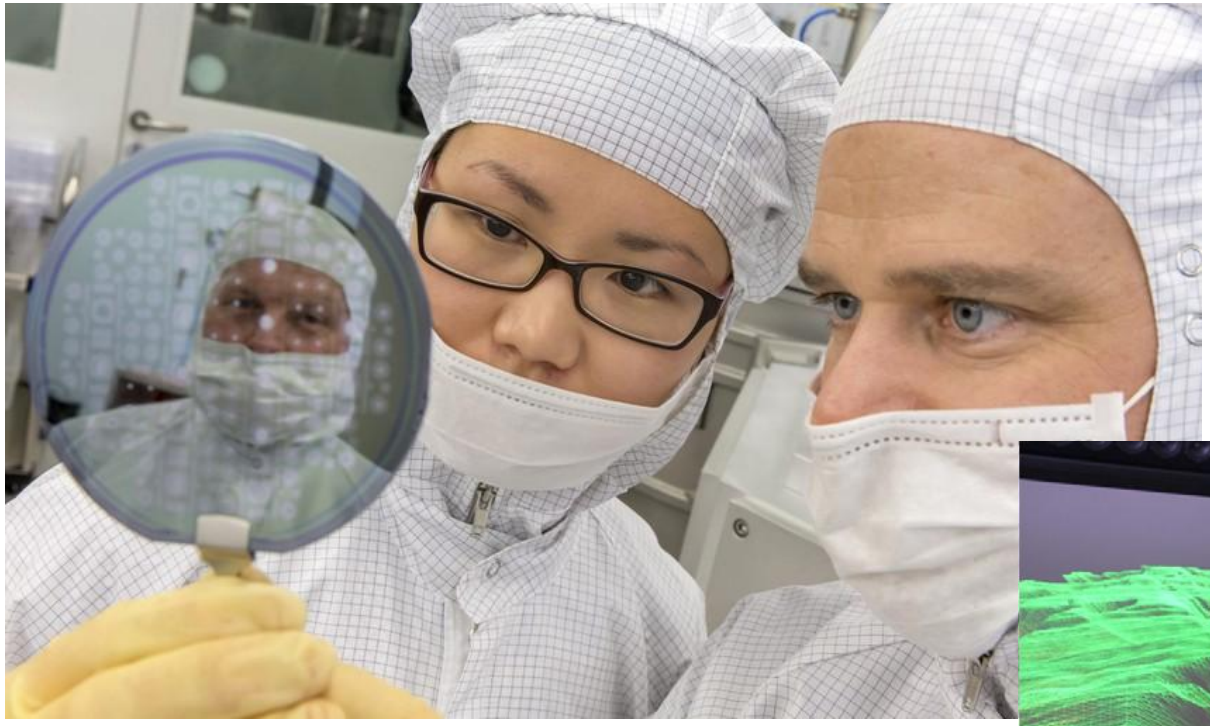
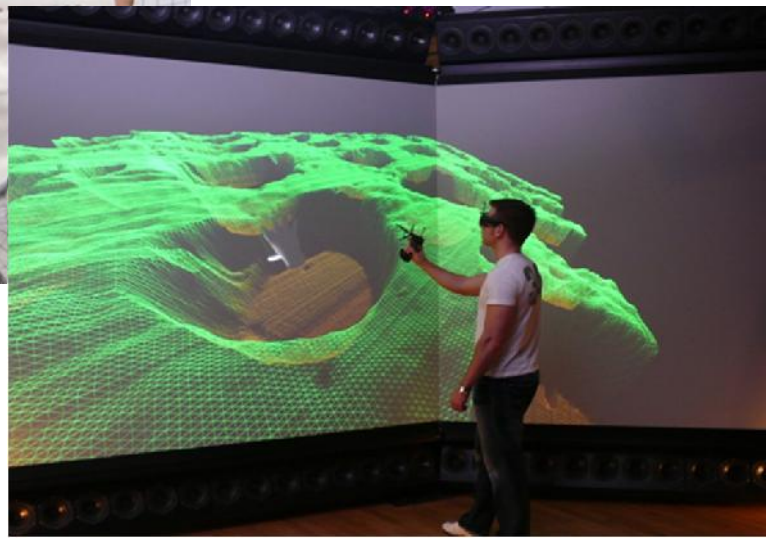
Research





Research in interfaculty research Clusters

Microsystems and Nanosystems

- Nanoengineering
- Precision Engineering and Precision Measurement Technology
- Technical and Biomedical Assistance Systems
- Drive, Energy and Environmental Systems Technologies

Smart Systems Engineering and IT

- Digital Media Technologies
- Mobile Communications

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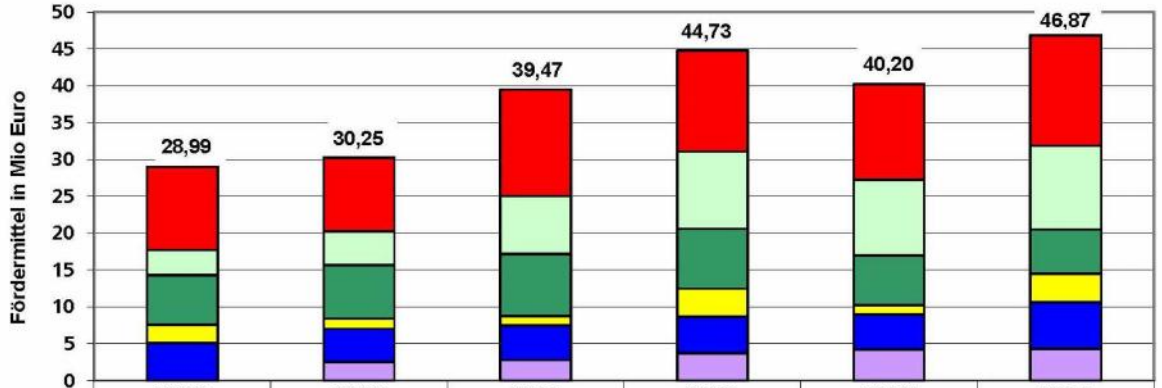
Third-party Funding



	2009	2010	2011	2012	2013	2014
Bundesfördermittel	11,29	10,01	14,43	13,68	12,95	15,01
Landesfördermittel	3,44	4,59	7,89	10,48	10,30	11,38
DFG	6,71	7,25	8,39	8,09	6,71	5,99
EU (ab 2006 ohne Leonardo)	2,45	1,38	1,30	3,82	1,28	3,87
freie Drittmittel (Industrie)	5,11	4,51	4,68	4,96	4,73	6,34
Sonstige *)	0,00	2,51	2,78	3,70	4,23	4,28

Third-party funding in 2014:

- Total: **46.9 Mio EUR**
- **“Efficiency” per professor: ~ 460TEUR**
  (10th place in a Germany-wide comparison)

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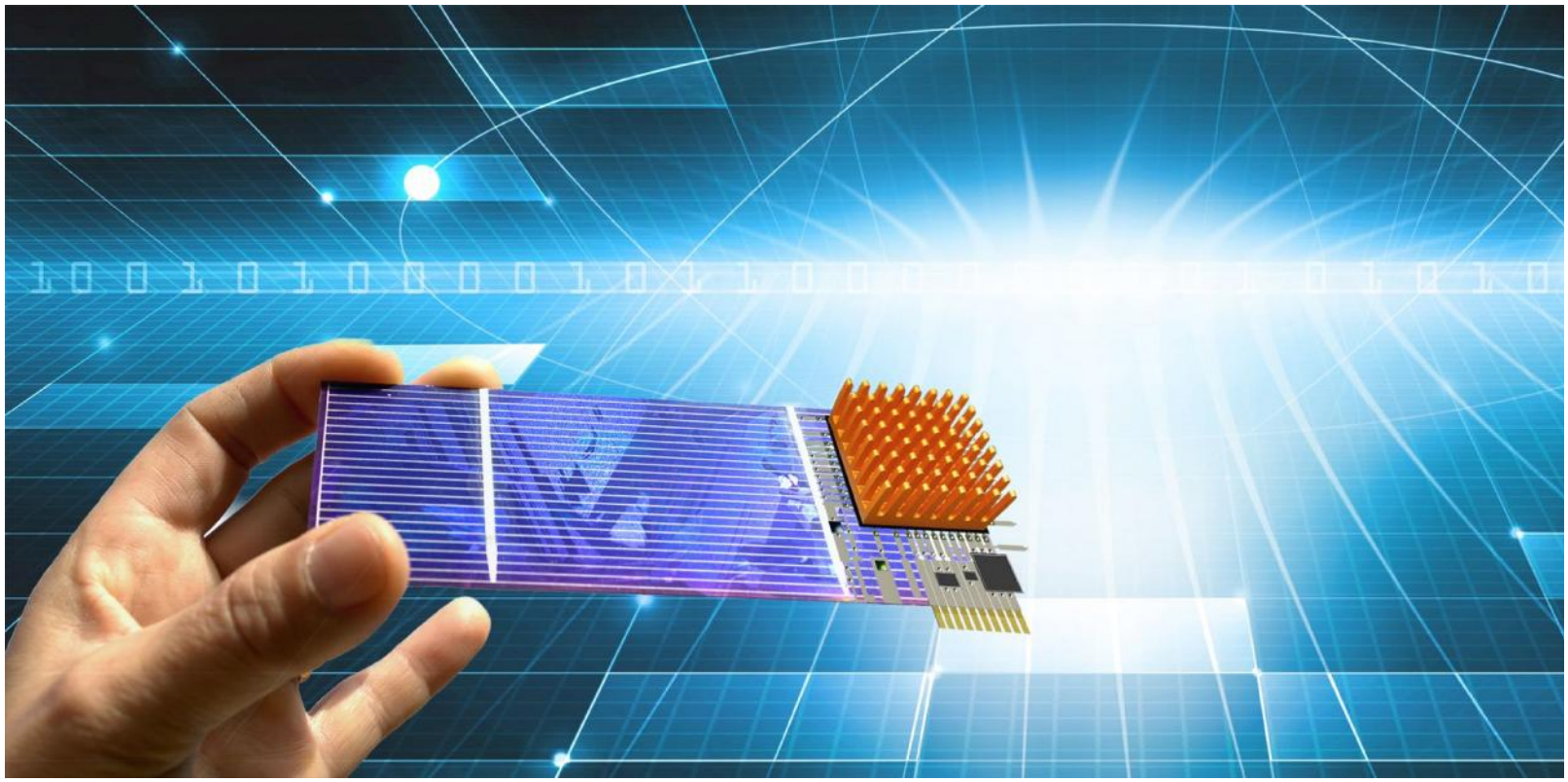

Research and Development from Material to Smart Grid (whole value chain)

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Research clusters of TU Ilmenau offer

→ best conditions (staff, infrastructure, BSc/MSc/PhD programs)
for research & development and for academic education
in PV and renewable energy technologies

→ Research and education
from material to
smart grid

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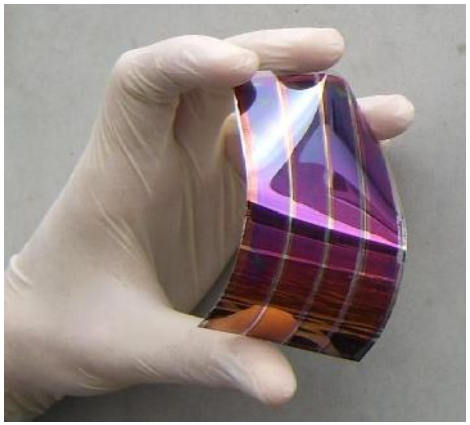
PV/Renewable energies as an essential main activity of TUIL has been established ~20 years ago

Education **Research** **International cooperation**



Education

- Endowed Professorship (sponsored by a syndicate of PV companies)
  Photovoltaics (W3)

- New Master‘s program
  Renewable Energy Technologies
  besides of existing programs

- Thuringian Graduate Research School PhotoGrad (14 PhD students)
  From Material to Smart Grid

- Annual *International Solarvalley Summer School for Smart Energy*

- *Further education* for specialists from industry

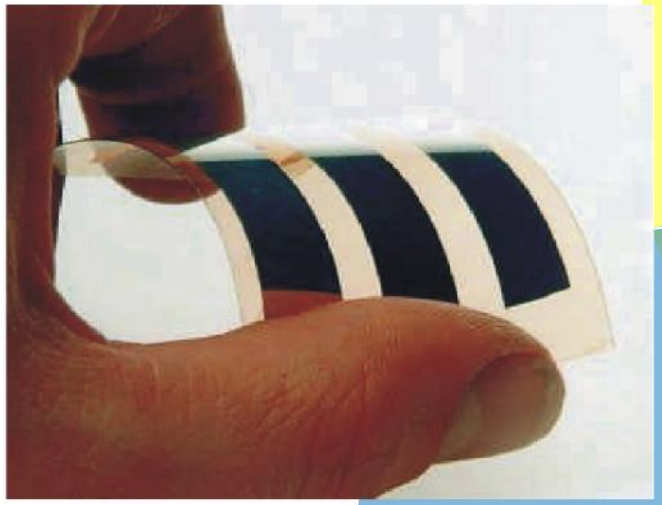
- *Practical trainings/Internships* for students from abroad

Research

- *From basics to application*
- Endowed Professorship (sponsored by syndicate of industry)
  Photovoltaics (W3)
- *Public funding* (DFG, BMBF, BMU, EU, …)
- Direct *financing by industry*
- *E.g.:* Top cluster competition (BMBF) *Solarvalley Mitteldeutschland*
  Mixed funding by BMBF (40 Mio EUR)
  and industry (+ 40 Mio EUR)

  (Cluster goal in 2008 when starting was:
  „Price of electricity produced
  by PV has to become lower than
  that by conventional power stations“)

e.g. Organic Solar Cell



→Chemical structure
→Blend morphology
→Device architecture

Efficiency (kW)

Stability (yrs)

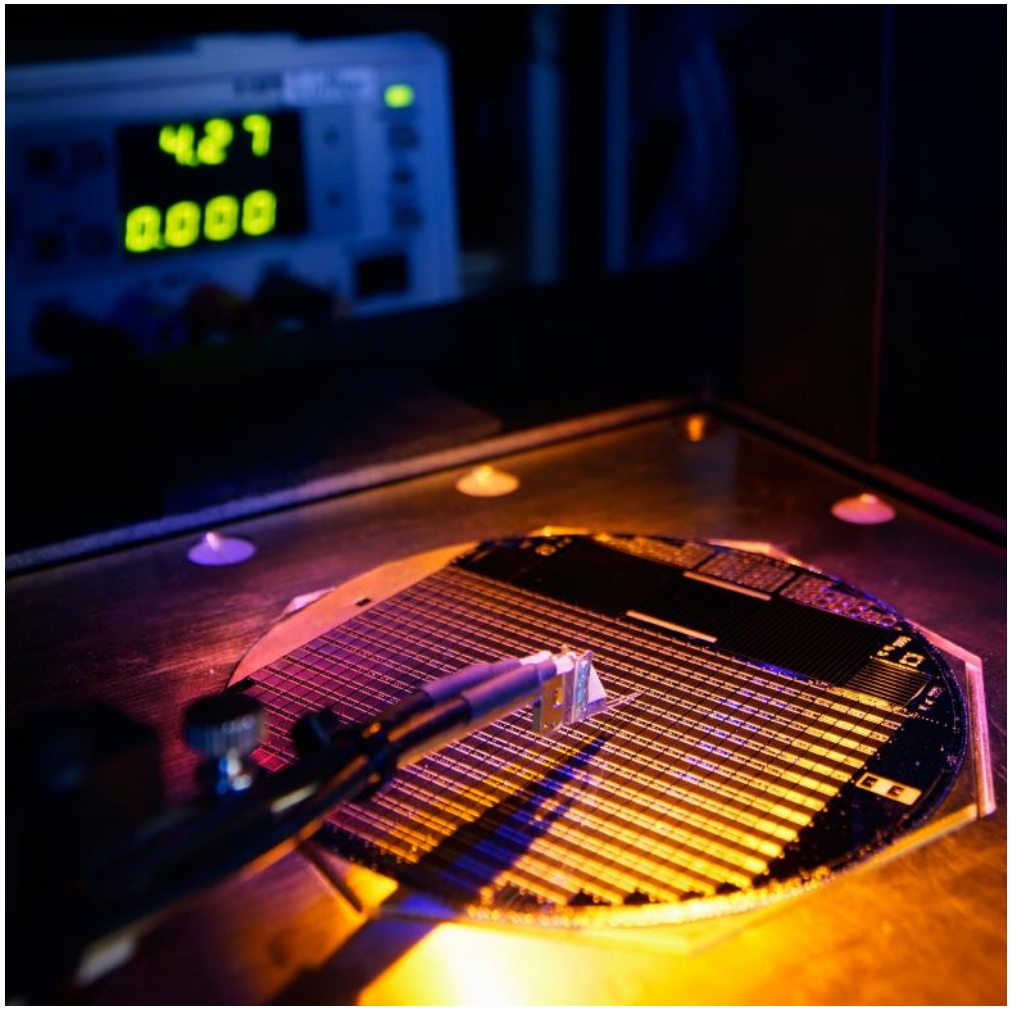
Price (EUR)

→ Chemical structure
→ Morphology
→ Device architecture

→Carrier substrate
→Photoactive materials
→Process control
→Roll-to-roll production

e.g. Concentrator Solar Cell with PCE=46%

(500 concentrator cells
on a 100mm Si wafer)



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International Cooperation:
Soitec,
CEA Leti
&
Fraunhofer ISE Freiburg,
TU Ilmenau (T. Hannappel,
endowed professorship)

Internationalization

- University cooperations
  financed partially by DAAD, …
  e.g. - University Ferhat Abbas, Sétif/ALG
  (in the framework of *German-Arab/Iranian Higher Education Dialogue Program*)
  - State University of St. Petersburg/RU

- African network for solar energy *ANSOLE e.V.*

- Many intense activities during start-up time of *PAUWES*
  (Panafrican University for Water and Energy Sciences, Tlemcen)

- Master‘s program *Energy Solaire* (Univ. Sétif) and
  Master‘s program *Applied and Computational Physics (ACOPhys)*
  (Univ. St. Petersburg)

- Practical trainings, joint conferences, master‘s & PhD thesis, …
  E.g. recently Lazar Lalaloui and Mohamed Megazi at TU Ilmenau

Cooperation between Université Sétif 1 and Technische Universität Ilmenau

•Very close **cooperation since 1979**: IOMP

•Updating the **cooperation agreement**, signed by Profs. Abdel-Madjed Djenane and Peter Scharff

•Application for a **common project** (2018-20) within the DAAD program *University dialogue with Islamic World*: "Practice-oriented teaching and research for innovative career opportunities of graduates on the topics Optics/Green Photonics and PV"

Focus: Practical training

Setif (2008)

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Internship with practical training of Master‘s students from University Sétif at TU Ilmenau, 2011

Journal of Studies in International Education OnlineFirst, published on January 26, 2009 as
doi:10.1177/1028315308331293

German–Algerian University Exchange from the Perspective of Students and Teachers - Results of an Intercultural Survey

Nicola Döring
Ilmenau University of Technology, Germany
Kamel Lahmar, Mohamed Bouabdallah, Mohamed Bouafia, Djamel Bouzi
Ferhat Abbas University of Sétif, Algeria
Gerhard Gobsch, Erich Runge
Ilmenau University of Technology, Germany

Journal of Studies in International Education J. Studies Int. Education **14** (3), 240-258, July 2010.

10.1177/1028315308331293 http://jsie.sagepub.com hosted at http://online.sagepub.com

ISWI – International Student's Conference at TU Ilmenau

since 1993
2017: **Global Justice – A Fair(y) Tale?**, 370 participants from 40 countries

Innovation in PV through industrial and international collaboration

Funding of research by industry
Pro‘s & Con‘s

- Direct way to application of newest scientific results
- In many cases money is given without too much „bureaucracy“
- Collaboration with industry → jobs for young graduates
- Strong motivation for starting an own start-up after university

- Freedom of science is occasionally limited e.g. for endowed professorships,
  (←→ A. v. Humboldt: freedom of teaching and research)
- Number of scientific publications is often limited (industrial secrets)
- strongly depending on the economic standing of companies
  (e.g. during the recent crash of European/German solar industry)

Innovation in PV through industrial and international collaboration

Internationalization - advantages & but still difficulties

- Science is a global process → of course universities need a strong international network
- international collaboration → reduction of world-wide conflict potential,
- excellent possibility to offer students esp. from third-world countries high-tech
- Use of international science organizations and laboratories
- Double degree programs →offer implementation of internat. standards
- Exchange of talented MSc and PhD students

- Still there is an asymmetry of student‘s exchange with 3rd world-countries esp. for MINT studies → lack of technological/experimental equipment in many third-world universities has to be closed soon

Jobs after university – INOVA at TU Ilmenau

job exhibition
job fair
job bazaar

Start-up founding – support by TU Ilmenau

Technology and Incubator Center: TGZ

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Let‘s looking forward to a great future
by strengthening the scientific cooperation
between our both universités and countries

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Special Research Activities

- Thuringian Innovation Center for **Mobility**
- Thuringian Innovation Center for **Mechanical Engineering**
- Competency Center **Nanopositioning and Nanomeasuring Machines**
- Research Groups / Graduate Research Schools (PhD)
  - 3D Nanostructuring
  - High-Voltage Technologies
  - Lorentz Force Velocimetry and Lorentz Force Eddy Current Testing
  - Photovoltaics – from material to smart grid (**PhotoGrad)**

Increase of Efficiency (PCE) in PV