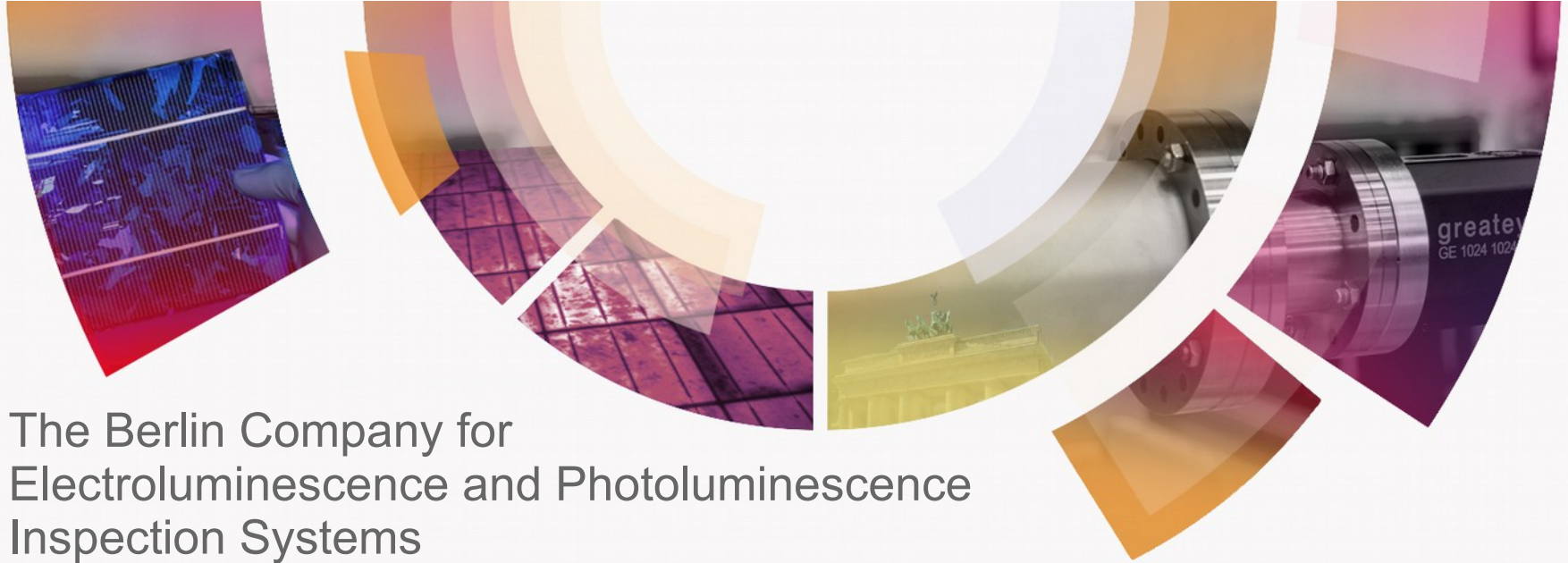


DISCOVER WHAT
THE EYE CAN'T SEE

greateyes



The Berlin Company for
Electroluminescence and Photoluminescence
Inspection Systems

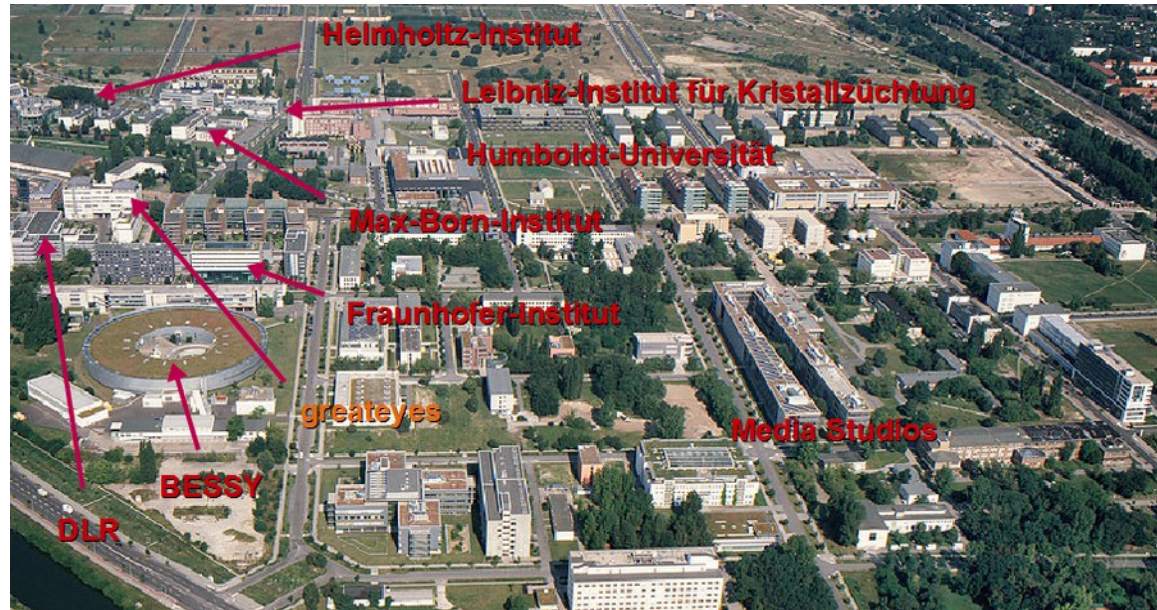
Ivan de la Cruz,  ISO-DYNAMIQUE , exclusive partner of greateyes in Thailand

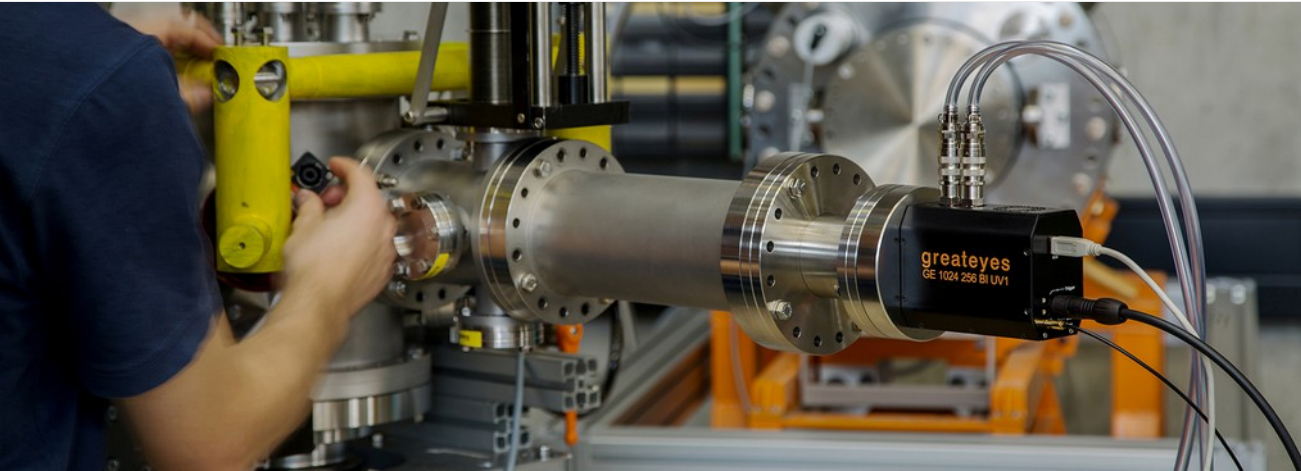
„greateyes develops, manufactures and markets high performance digital cameras as well as optical inspection systems for the solar industry.“

- Founded in 2007 by Dr. Martin Regehly and Michael Menz
- Currently 22 Employees
- Headquarters in Berlin, local partners in 21 countries
- Two business units: (I) scientific cameras, (II) inspection systems
- International customer base – mainly in Asia, Europe, and the U.S.
- Winner of Innovation Award Berlin-Brandenburg 2010
- Focus on innovations
- Powerful cooperation partners (joint R&D projects with Humboldt-Universität Berlin, Max-Born-Institute, DLR – national aeronautics and space research centre of the Federal Republic of Germany, ...)



Located in Berlin Adlershof, Science and Technology Park

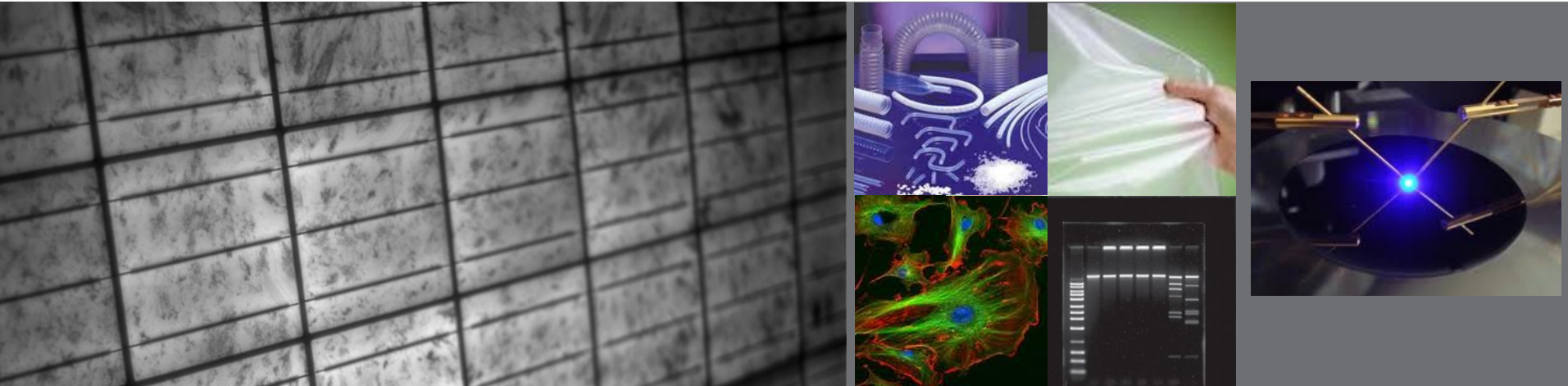




- High quantum efficiency from NIR to X-ray
- Low readout noise
- Deep cooling
- High dynamic range
- Compact design
- Broad portfolio
- Customized solutions

(I) Scientific high-performance CCD cameras

- More than 20 different sensors for X-Ray, EUV, UV, VIS and NIR applications
- Pixel array: 1024×1024 , 1024×256 , 2048×512 , 2048×2048 , and 4096×4096
- Read noise of $2.4e^-$, Cooling down to -70°C , 16 bit ADC



(II) Optical Inspection Systems

- Inspection of Photovoltaics
- Wafer & Semiconductor Characterisation

- Life Sciences
- Inspection of Plastic Materials



- Systems for the whole value chain: as-cut wafer, solar cell & solar module inspection
- In-line & off-line
- R&D, production, yield optimization, reliability, defect analysis, inspection of PV power plants

Inspection of Photovoltaics: Wafer, Solar Cells, and Modules

greateyes inspection systems are characterized by:

- Market leading sensitivity
- Brilliant image quality
- User friendly software/HMI
- Smart defect algorithms

Advantages of EL & PL inspection:

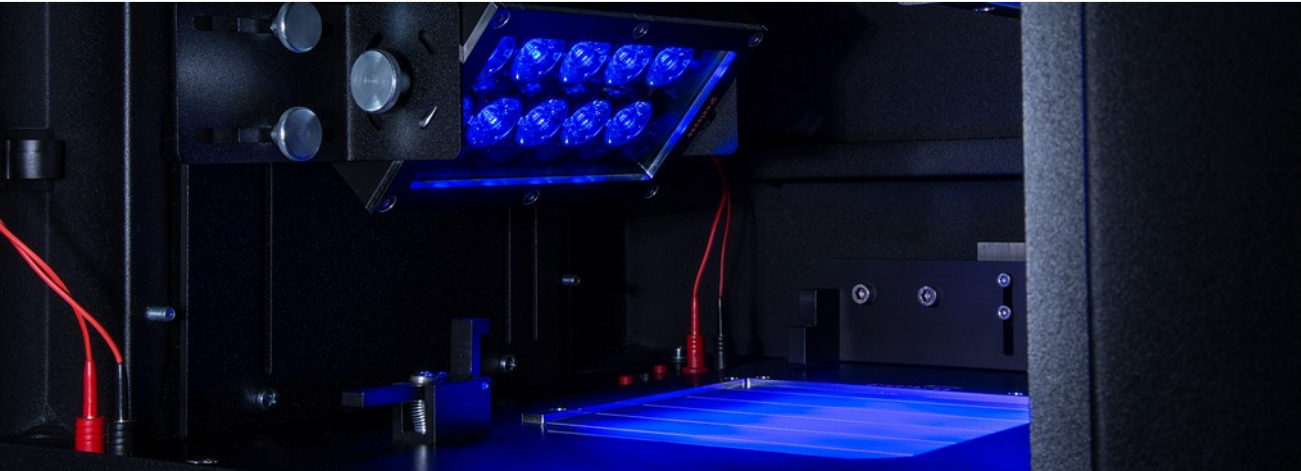
- High informational content
- Invisible defects show up
- Fast measurement, in-line capable
- PL is a contact free method → no cell breakage
- Applicable along the whole value chain

A EL/PL system can help to:

- Optimize solar cells/modules
- Increase cell/module efficiency
- Maintain high quality standards
- Track problems along the production
- Increase yield
- Reduce production cost

What can be detected or measured with greateyes systems?

- | | | |
|---------------------|---------------------------|------------------|
| • Micro-cracks | • PID | • Local lifetime |
| • Shunts | • Hot spots | • Impurities |
| • Finger interrupts | • Silver paste properties | • Dislocations |
| • Inhomogeneities | • Series resistance | |

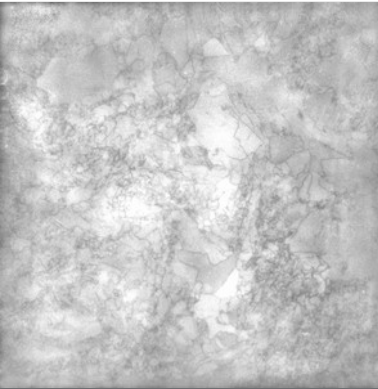


LumiSolarCell

- Wafer & solar cells
- Innovative, HighPower LED light source
- For R&D, production, characterization and qualification, failure analysis, ...

Wafer and Solar Cell Inspection

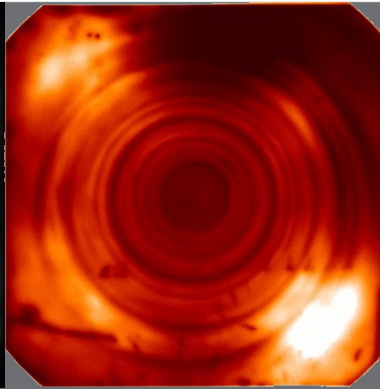
- Worlds-first LED-based PL system, additional features: EL, R_s , IR (LIT) & lifetime mapping
- USPs: compact, scalable, low-maintenance device, no laser safety regulations apply
- Off-line, automated batch system, OEM in-line, pure PL or EL, combined EL/PL, or EL/PL/IR



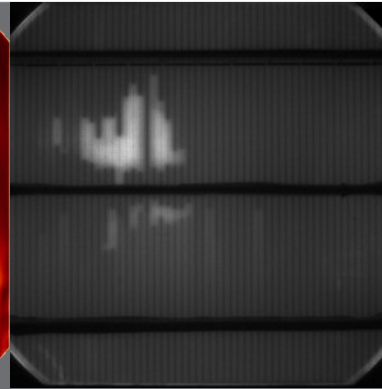
PL, as-cut poly c-Si
wafer



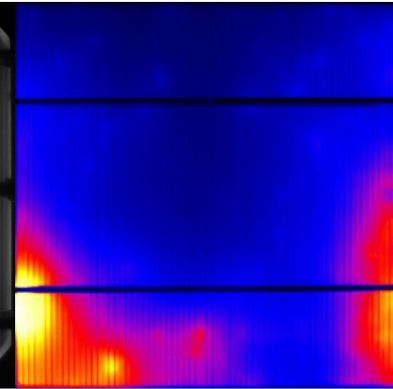
PL, AR coated mono
c-Si wafer



PL, Czochralski
wafer



R_s , mono cell



DLIT, cell

Wafer and Solar Cell Inspection

- Electroluminescence (EL), reverse biased EL, and series Resistance (R_s)
- Photoluminescence (PL) and biased PL
- Dark Lock-in Thermography (DLIT) and steady-state Thermography



- EL inspection of modules
- In-line, off-line in production environment
- Inspection of installed modules, PV systems
- High resolution
- Automated software analysis

Solar Module Inspection

- Customers: Manufacturers, R&D, Power/Retail/Service Companies, Certification Institutes
- Highest sensitivity and resolution, excellent image quality
- Turnkey systems, different system set-ups and options selectable

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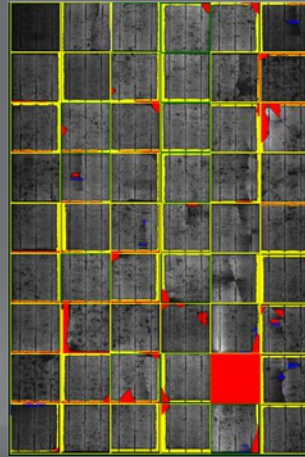


LumiSolarProfessional Inline

- Pre-laminates and modules
- Fully automated
- 24/7 approved
- Comprehensive defect analysis software
- User management

In-line Inspection of Pre-laminates or Solar Modules

- Fully automated system, PASS and FAIL decision based on customer defined criteria
- High throughput of up to 180 modules/h
- Integration before lamination, after lamination, at the end of the line, or into a flasher
- Software detects: micro-cracks, edge isolation, finger interrupts, rotated cells / bus bars, ...



LumiSolarProfessional

- EL inspection of modules
- c-Si, a-Si, CIGS, CdTe, HIT, ...
- Best resolution & image quality
- Customized solution for very large modules available
- Automated software analysis

Off-line Inspection of Solar Modules of all types

- Manual system, defect analysis software as upgrade
- Resolutions available from 8 – 300 megapixel
- No restriction on the type of module: Si-based modules and all types of thin films



LumiSolarOutdoor

- mobile, lightweight equipment
- modules don't need to be demounted
- measurements during late twilight or in the night
- system subtracts ambient light
- dark box is not necessary
- quick and reliable measurement

On-site Inspection of Solar Modules

- Highest sensitivity on the market, excellent image quality
- Identification of: **micro-cracks, PID, defective bypass diode, finger interrupts, ...**
- Turnkey system, two versions available: battery-powered and line-powered

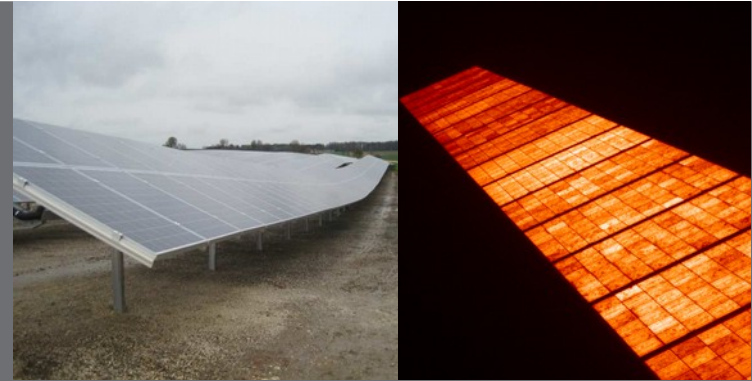


Inspection of single modules with
battery-powered system

Both versions suitable
for:

- Field installations
- Rooftop installations

No preparation work
on-site necessary!



Inspection of strings with
line- powered system

LumiSolarOutdoor Battery-powered

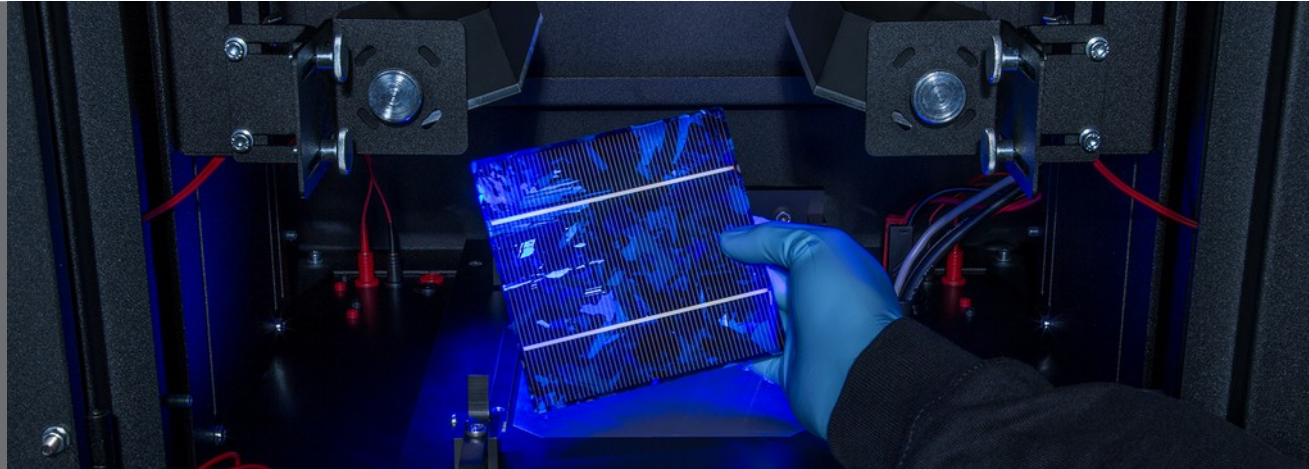
- Independence from local power grid
- Approximately 200-500 measurements per battery charge
- 3rd innovation prize at the prestigious Bad Staffelstein Symposium

LumiSolarOutdoor Line-powered

- A whole string is electrically powered
- Connect once and inspection in a stepwise procedure
- Abridged total measurement time

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Thank you!

- + World leader for High-Power LED based PL inspection technology
- + Cost, safety and maintenance much better compared to laser based PL
- + 24/7 proven functionality
- + World-wide sales of EL & PL systems
- + Solutions for in-line as well as off-line and outdoor applications