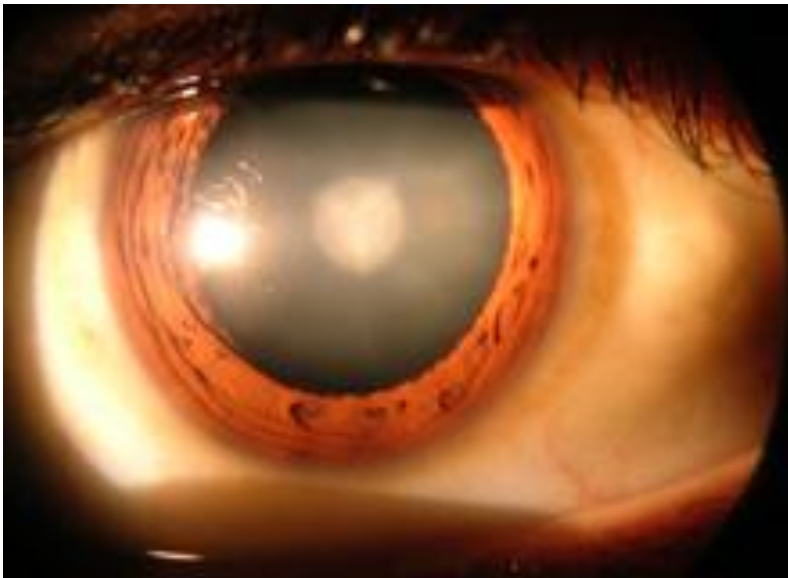


- Intelligente Biomaterialien - welche Optionen bietet die Nanostrukturierung von Oberflächen

Prof. Dr. Joachim Spatz
**MPI for Intelligent Systems & University of
Heidelberg**

Dr. Christian Lingenfelder,
alamedics GmbH & Co.KG

Katarakt (grauer Star)



http://commons.wikimedia.org/wiki/File:Cataract_in_human_eye.png



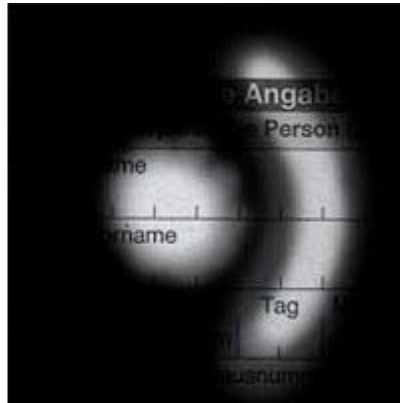
<http://de.wikipedia.org/wiki/Datei:Grauerstar-1.jpg>



<http://de.wikipedia.org/wiki/Datei:Grauerstar-2.jpg>

Glaukom (grüner Star)

	Steuernummer	
10	Allgemeine Angaben	
	Steuerpflichtige Person (Stpfl.)	
	Name	
	Vorname	
	Geburtsdatum Tag Monat	
	Straße und Hausnummer	



<http://www.bbsb.org/infothek/das-auge/sehbehinderungen-simulator/206-simulation-gruener-star-formular>

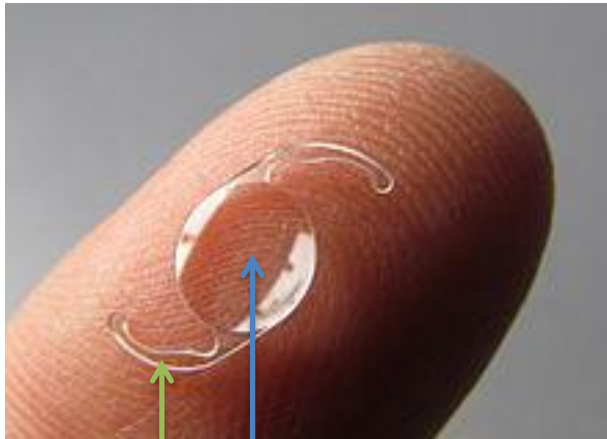
Altersbedingte Makula Degeneration (AMD)



<http://commons.wikimedia.org/wiki/File:Makuladegeneration-2.jpg>

<http://de.wikipedia.org/wiki/Datei:Makuladegeneration-1.jpg>

■ Katarakt: Linse (IOL)



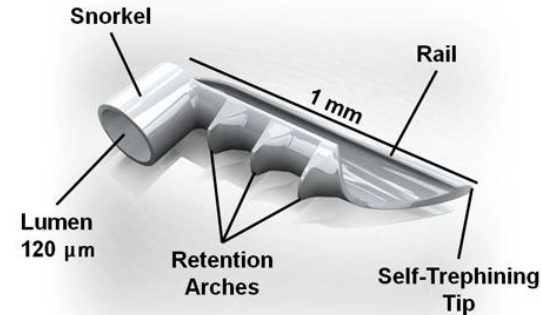
http://de.wikipedia.org/wiki/Datei:Hinterkammerlinse_01_%28fcm%29.jpg

Optik

Haptik

■ AMD: Teleskop

■ Glaukom: Stent



http://www.theengineer.co.uk/Pictures/web/q/t/k/TE_stent.jpg

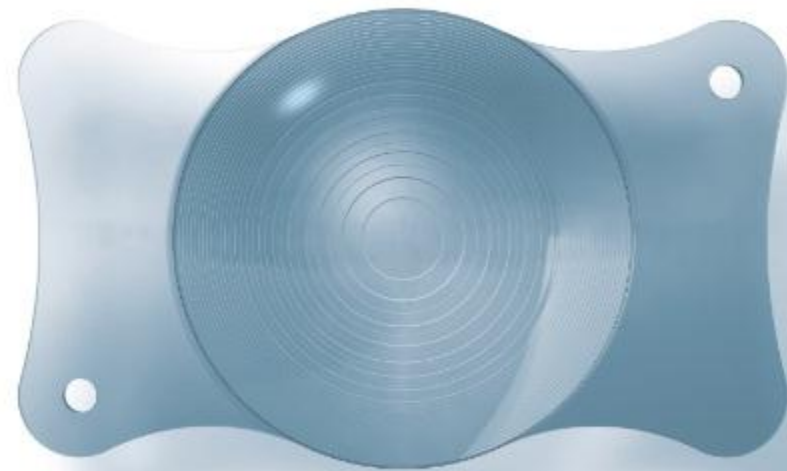


<http://www.visioncareinc.net/technology>

Oberflächen von IOL

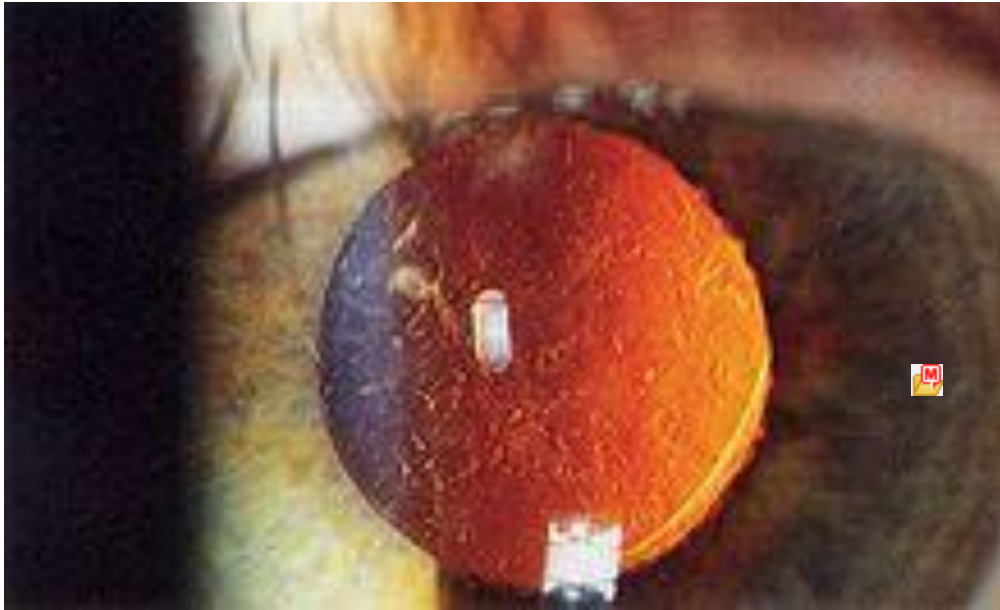


<http://www.optegra-deutschland.de/wp-content/uploads/Multifokallinse.jpg>



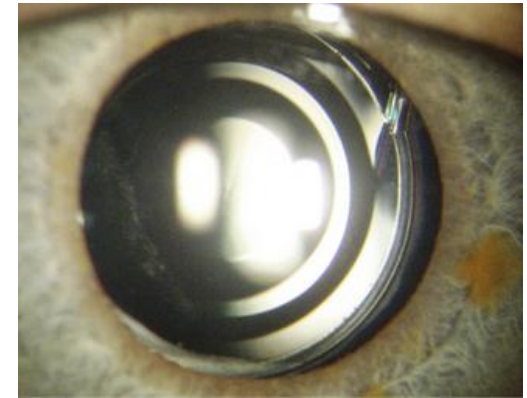
<http://www.optegra-deutschland.de/wp-content/uploads/Trifokallinse.jpg>

- **Nachstar (Sekundärkatarakt)**



http://commons.wikimedia.org/wiki/File:Posterior_capsular_opacification_on_retroillumination.jpg

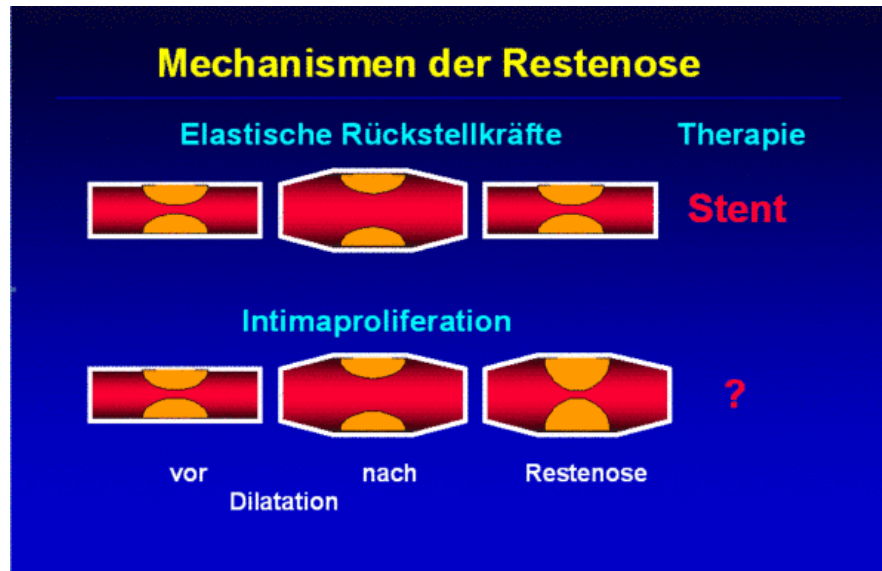
- **Hochbrechende Materialien:
Reflektionen**



http://www.em-consulte.com/em/SFO/rapport/file_100018.html



■ Glaukom: Restenosen

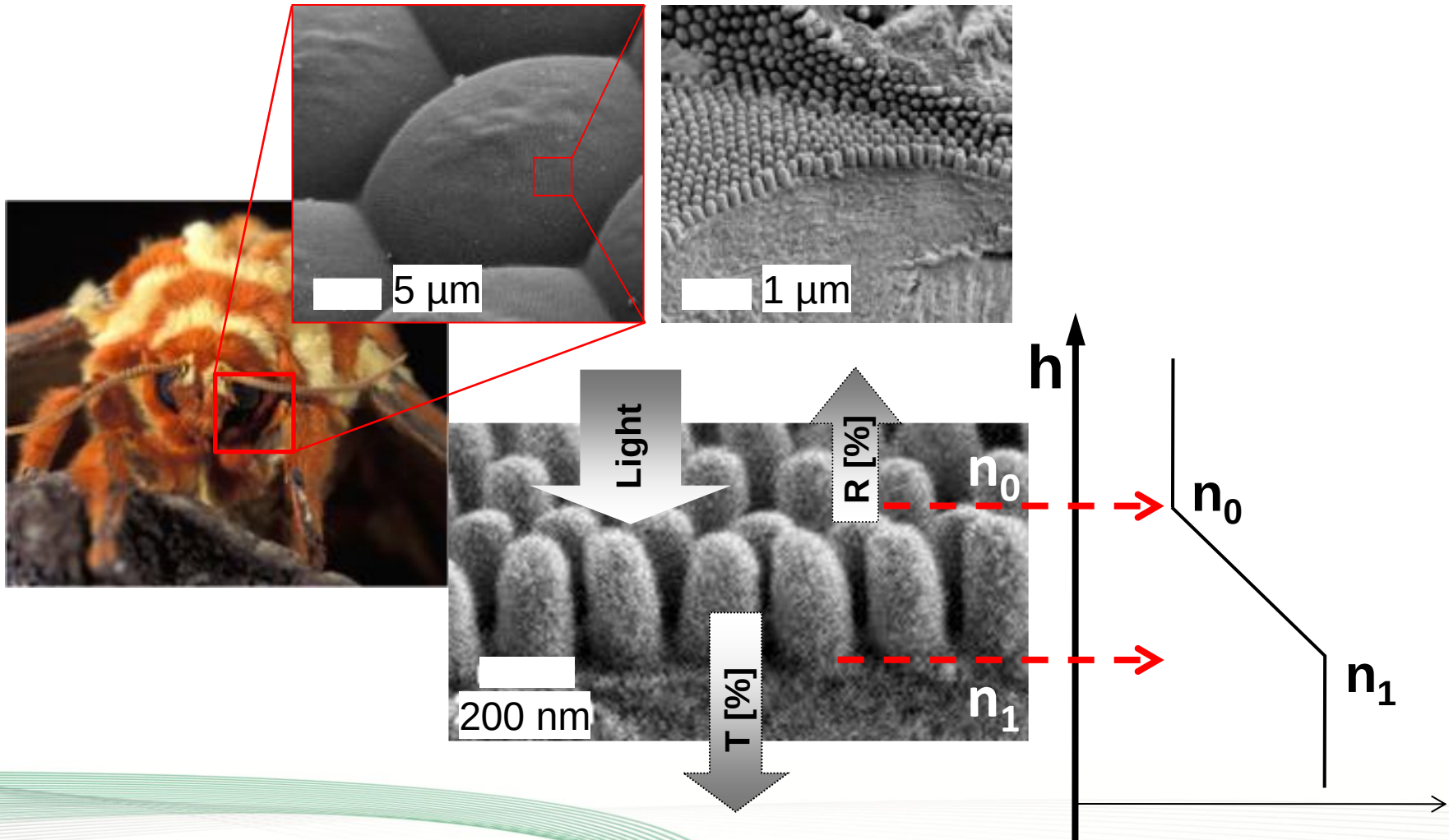


Brachytherapie

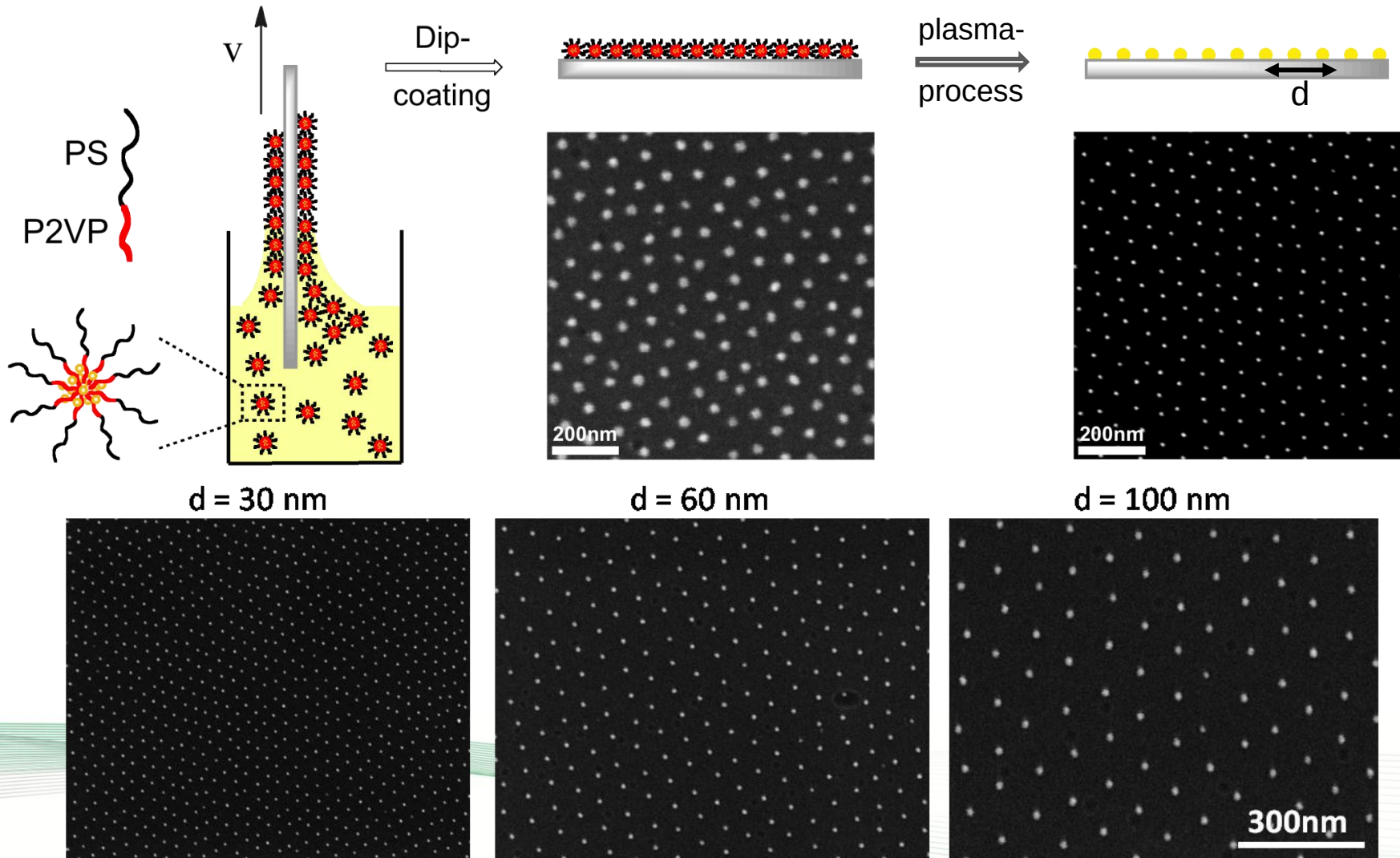
<http://www.uk-essen.de/kardiologie/brachytherapie>

■ Glaukom-Stent: Durchflusskontrolle – Stabilität des Augeninnendrucks

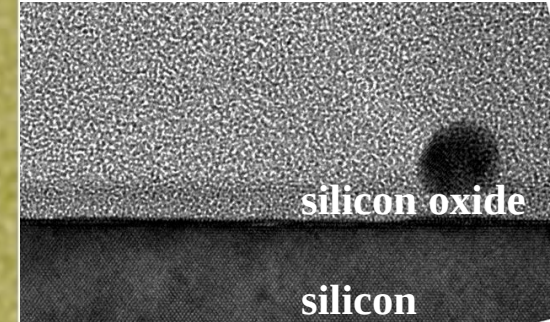
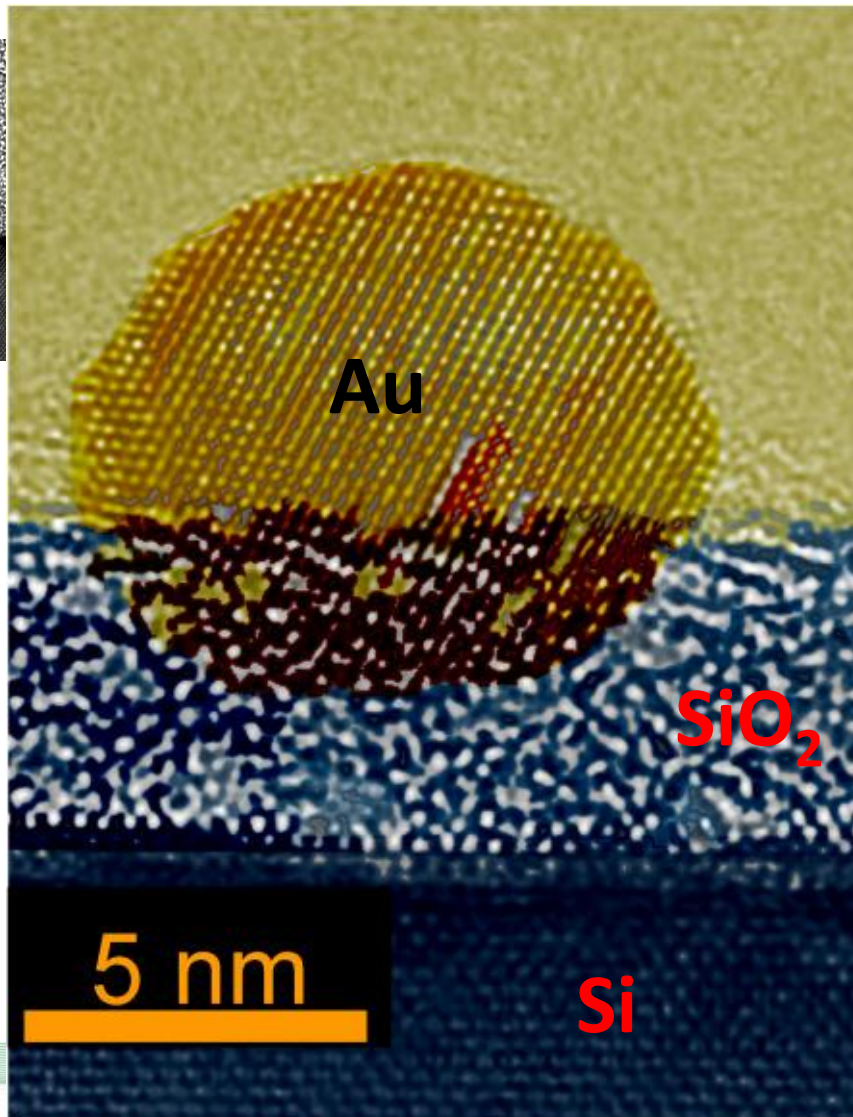
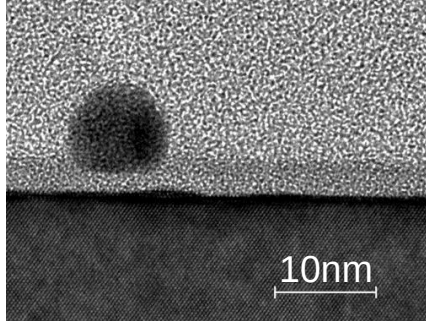
Mottenauge



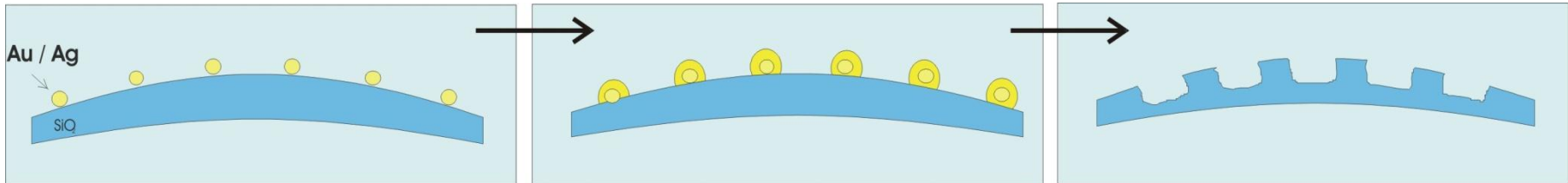
Base Technology: Block Co-polymer Micellar Lithography - BCML



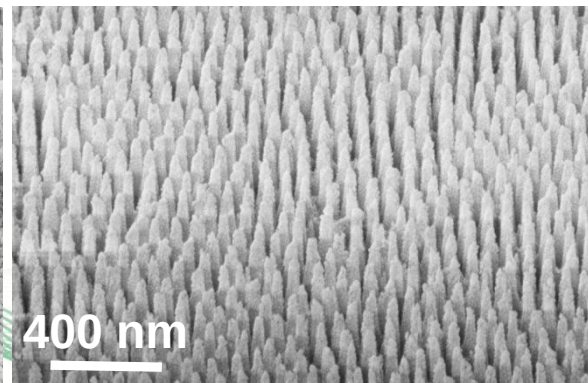
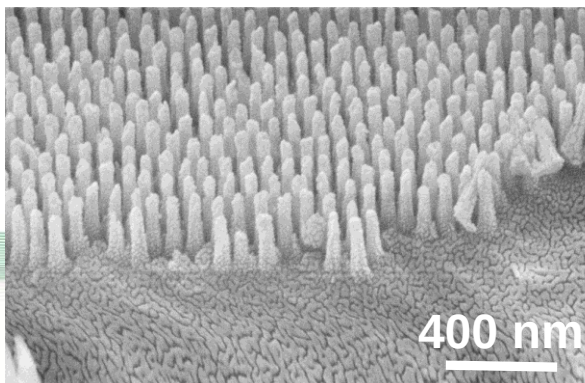
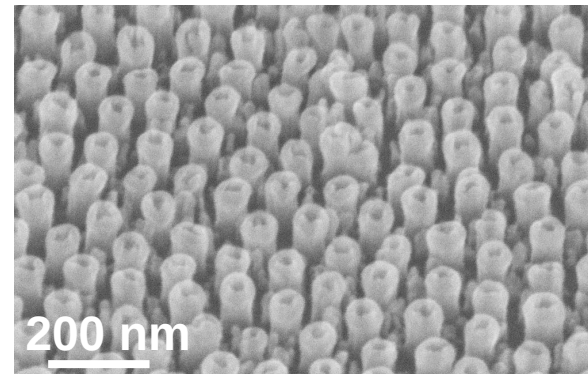
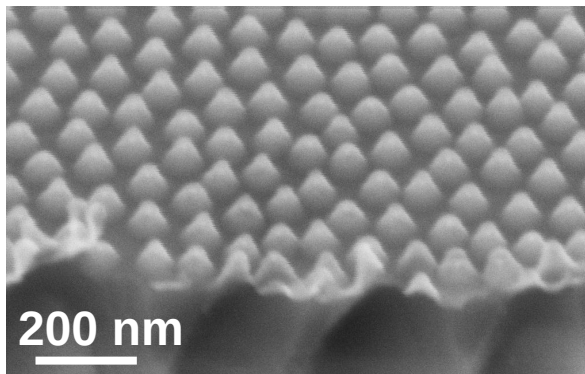
Nanostrukturierung von Oberflächen

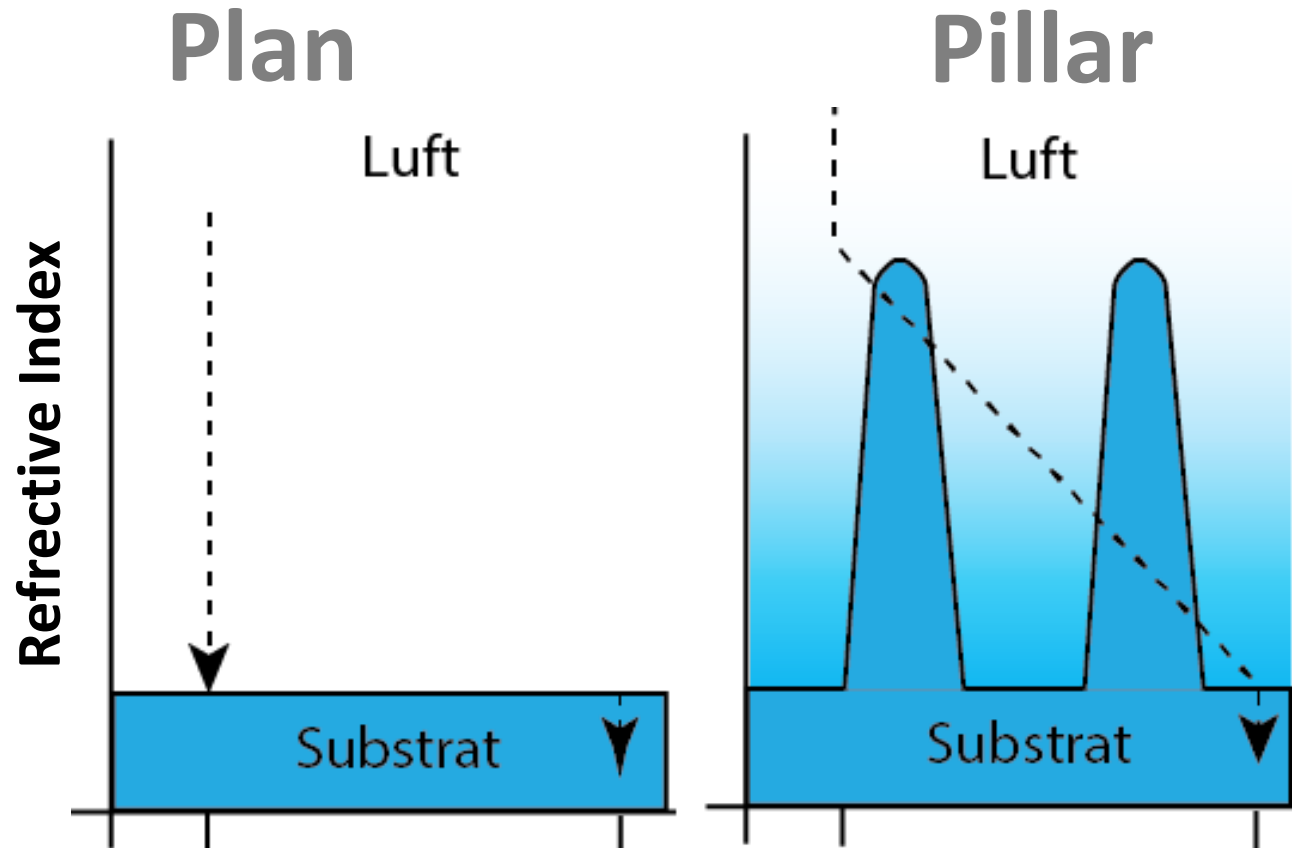


Optische Linse

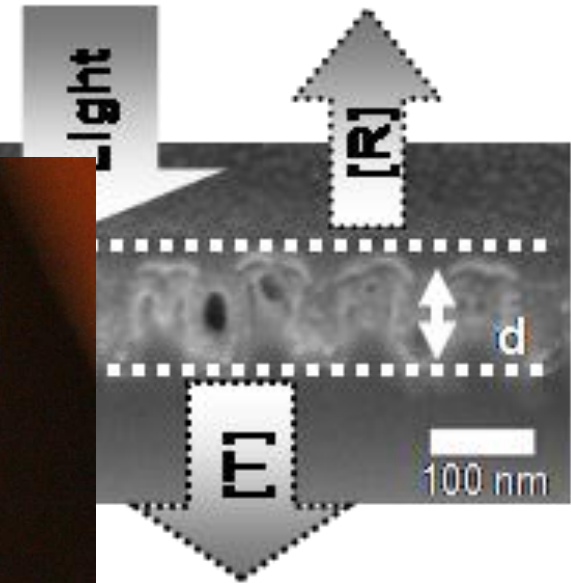
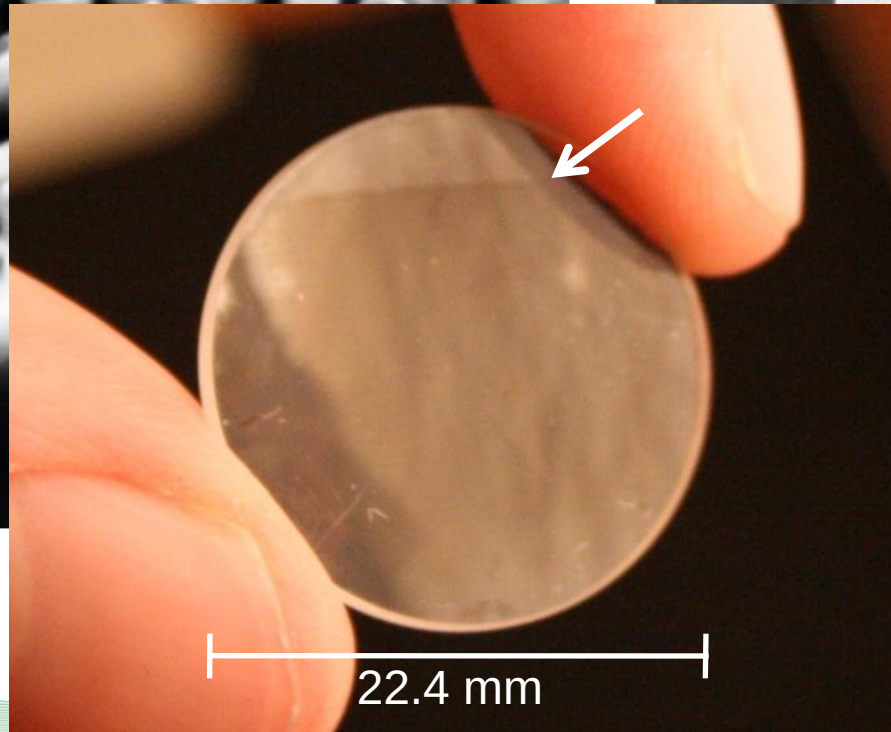
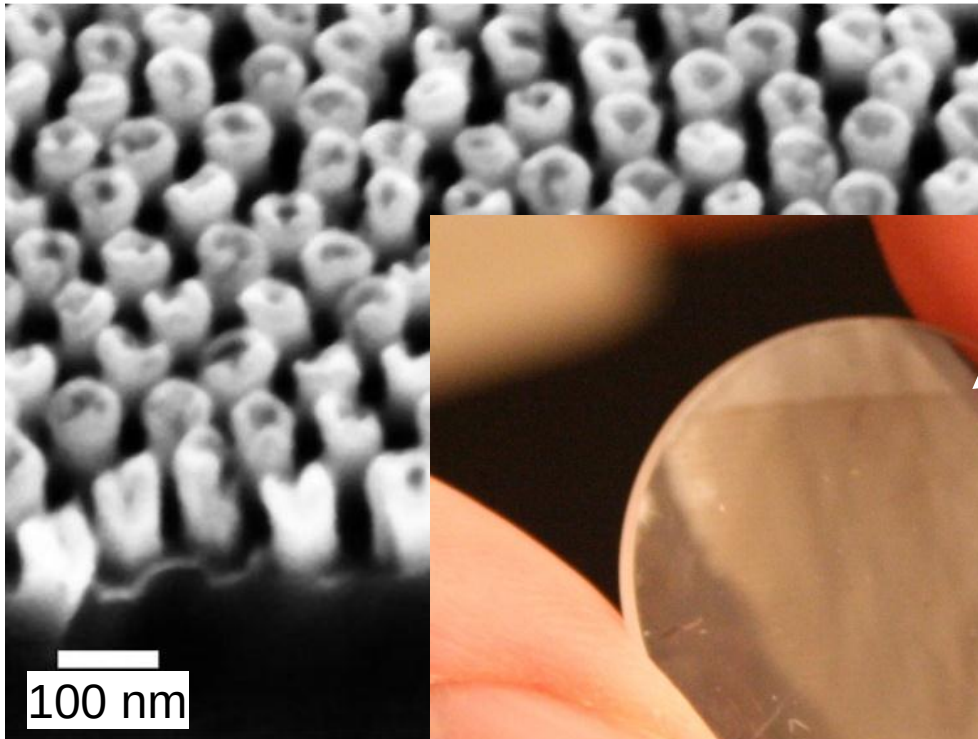


Nanostrukturierte optische Linse



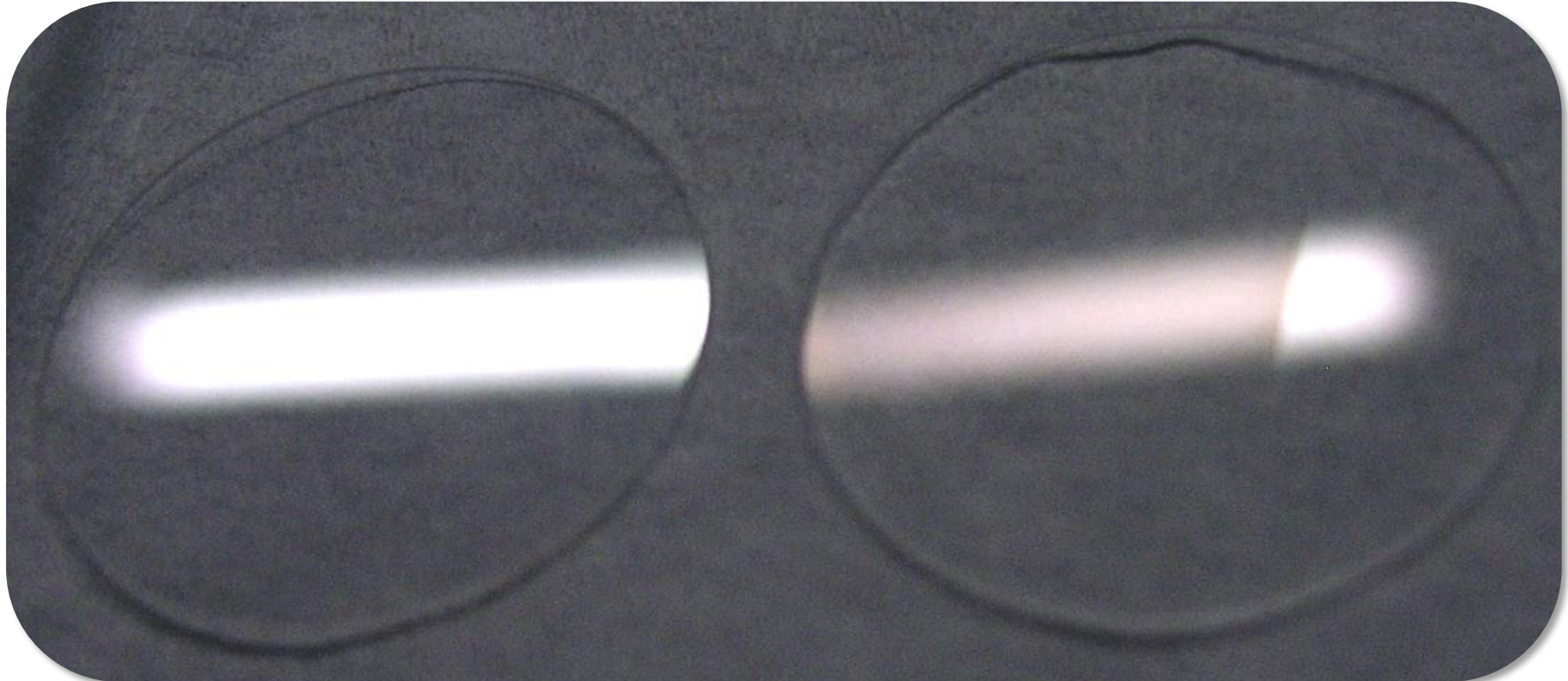


Biomimetische antireflektive Interfaces

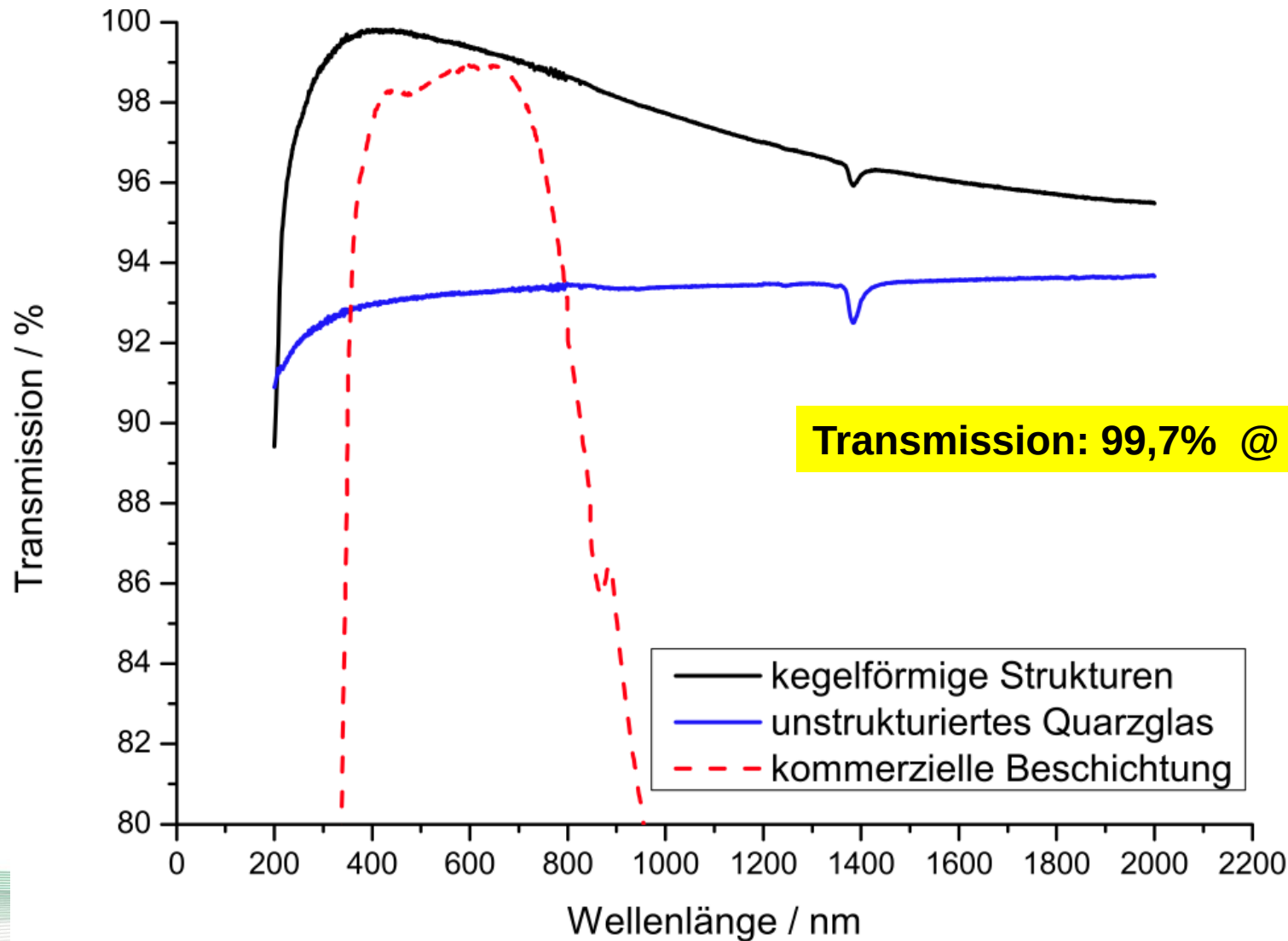


unbehandelt

nanostrukturiert

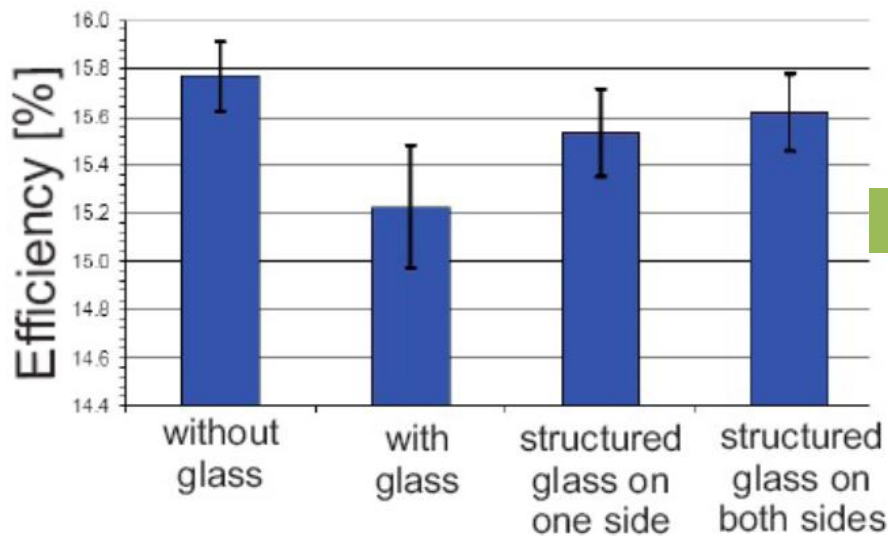


Transmission: 99,7% @ 490 nm



APPLICATIONS

Cover for Solar Moduls (BOSCH)



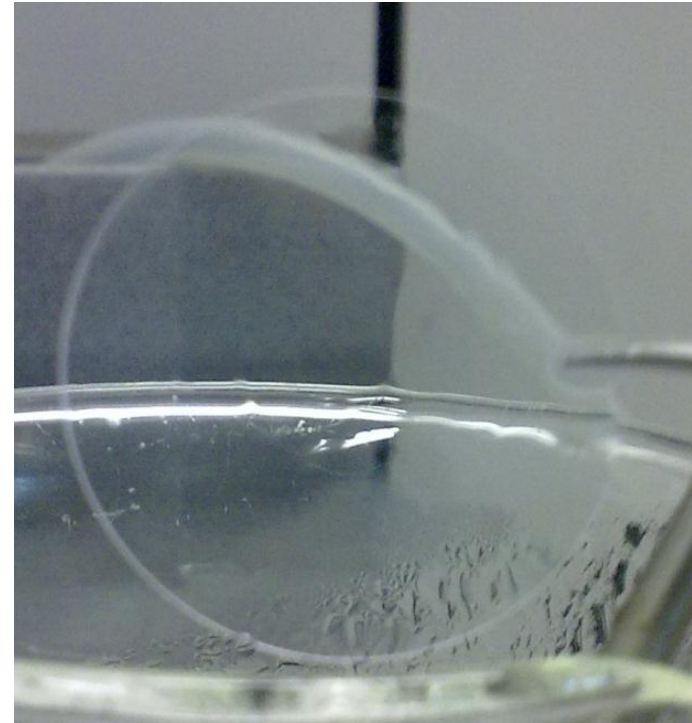
Head-up Displays (BOSCH)

Contact Lenses (Ciba Vision)

“Antibeschlag” - Eigenschaften

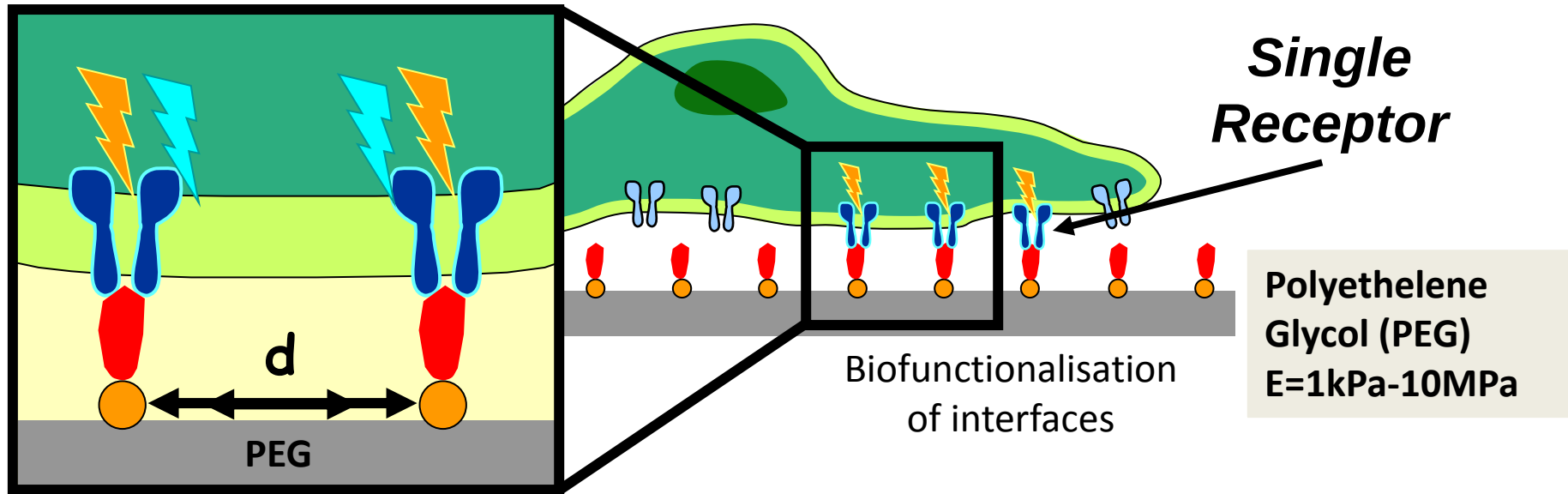


Normales Glas über kochendem Wasser



Antifogging-Effekt einer superhydrophilen Oberfläche

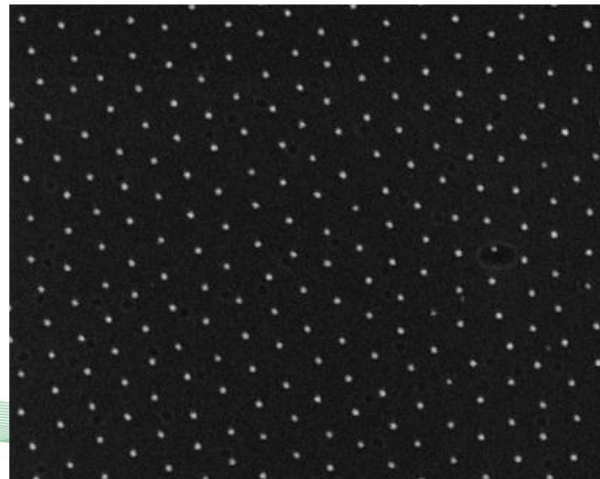
Material – Zelle Interface



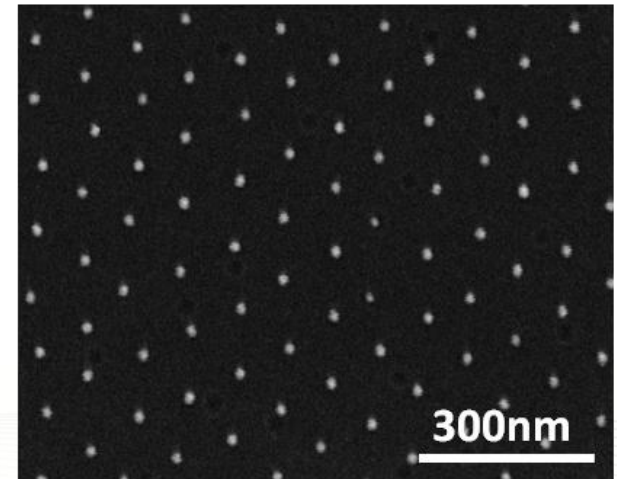
$d = 30 \text{ nm}$



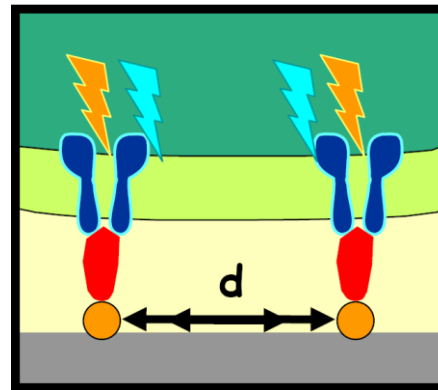
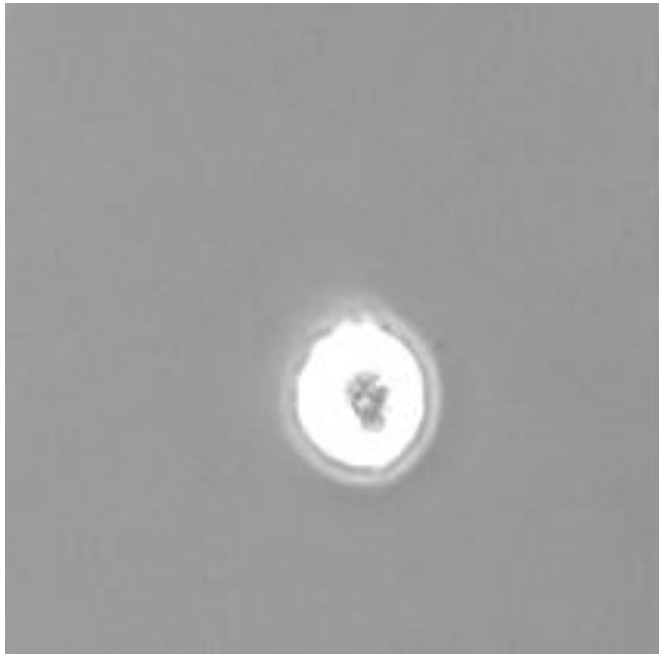
$d = 60 \text{ nm}$



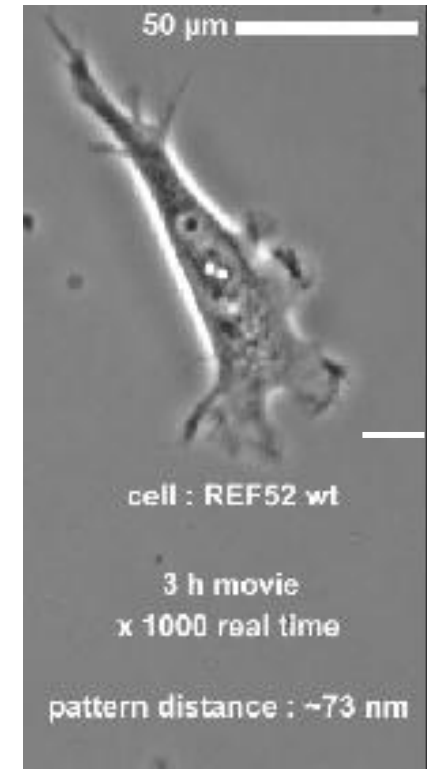
$d = 100 \text{ nm}$



**58 nm spacing
of RGD ligands**



**73 nm spacing
of RGD ligands**





Zelladhäsion auf Untergrund beeinflusst:

- Zellmorphologie
- Vitalität
- Motilität
- Proliferation
- Differenzierung
- Apoptose

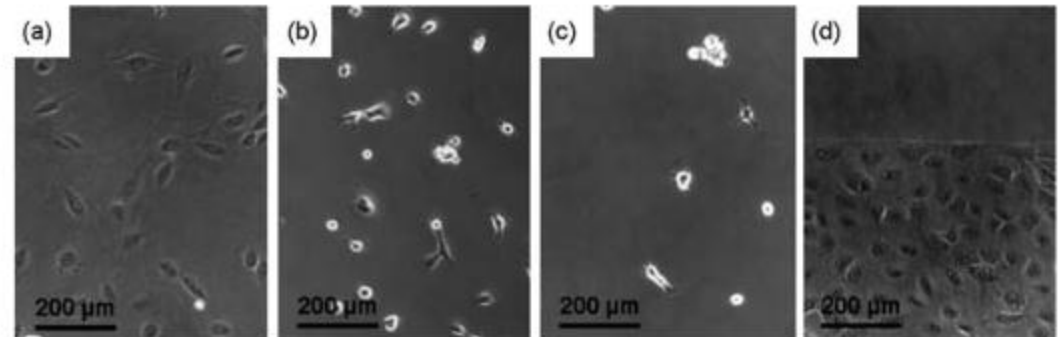
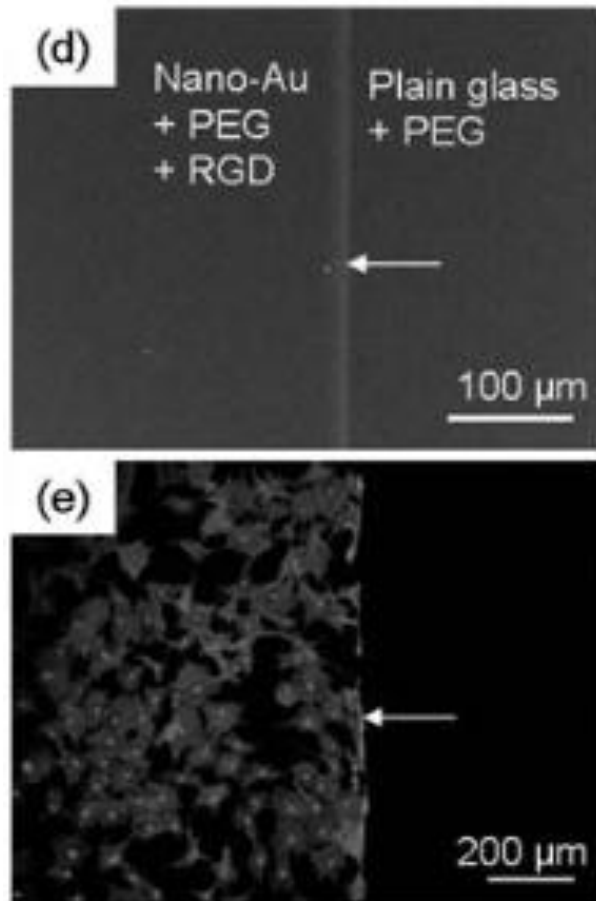


Fig. 4 Phase contrast optical micrographs of 3T3 fibroblasts cultured on nanostructured PEGDA 700 hydrogels. (a–c) Cells adhere on c(-RGDfK-)-functionalized ordered Au nanopatterns after 24 h in culture; the average spacings of nearby RGD are (a) 40 nm, (b) 80 nm and (c) 100 nm. (d) A micrograph around the dipping line after culturing cells for 14 days. The bottom part of the sample was patterned by RGD ligands with an average spacing of 40 nm. (Reproduced with permission from ref. 16, copyright 2007, American Chemical Society).

Zelle adhärirt bis zu einem bestimmten Abstand der präsentierten Liganden



- **Reduktion der Reflexion**
- **Erhöhung der Lichtausbeute (Transmission)**
- **keine farbliche Trübung**
- **Anti-Bakteriell**
- **Anti-Fogging - gezielte Gestaltung der Oberfläche (z. B. Kontaktwinkel)**
- **Regulation Material-Zell Wechselwirkung**
- **Biokompatibilität, Langzeitstabilität**
- **Keine Beschichtung - Identisches Materialsystem**



- **Neue Herstellverfahren**
- **Neue Materialien**
 - Kunststoffe
 - Faltbare Kunststoffe
- **Neue Linsengeometrien (dünner)**
- **Integration von Nanostrukturen in das Linsenmaterial (Optik & Haptik)**

Danksagung



MAX-PLANCK-GESELLSCHAFT



Dr. Fania Geiger
Wen Wen Chen
Michael Thaller



Dr. Martin Udart



Dr. Friedrich
Offenhäuser



**Bundesministerium
für Bildung
und Forschung**



Dr. Marc Awenius
Andreas Simon