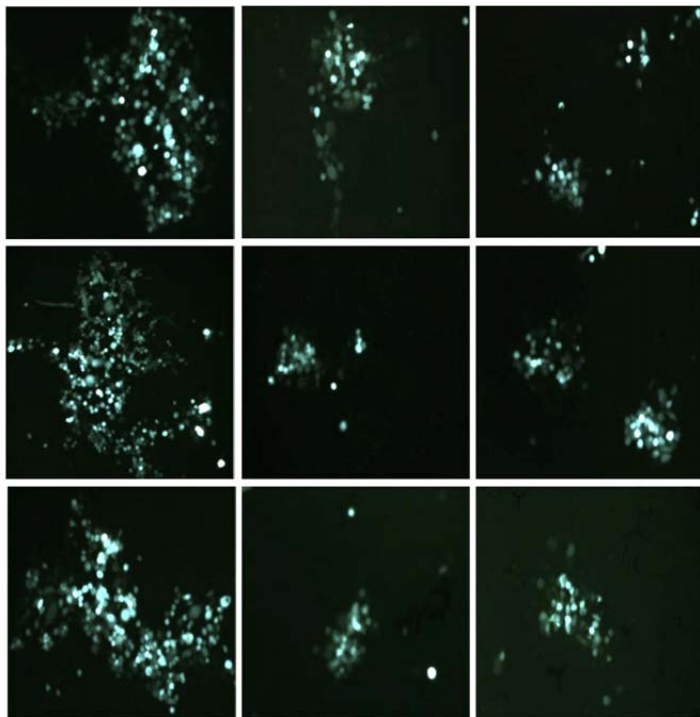


Antiviral wirksame Halbleiter – Umsetzungsmöglichkeiten für die Praxis

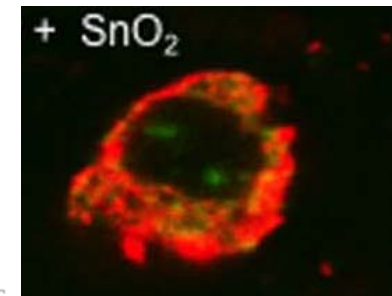
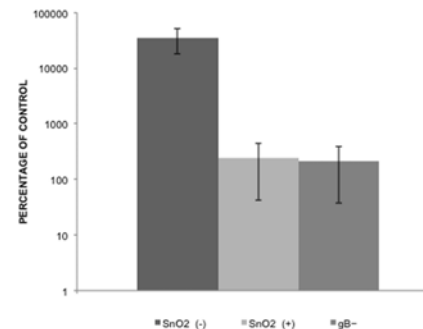
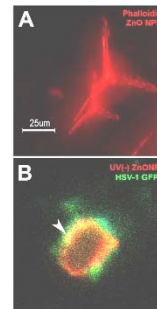
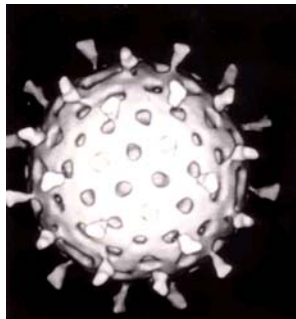
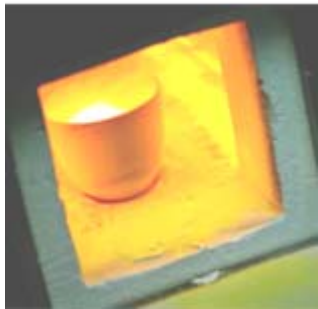


Rainer Adelung

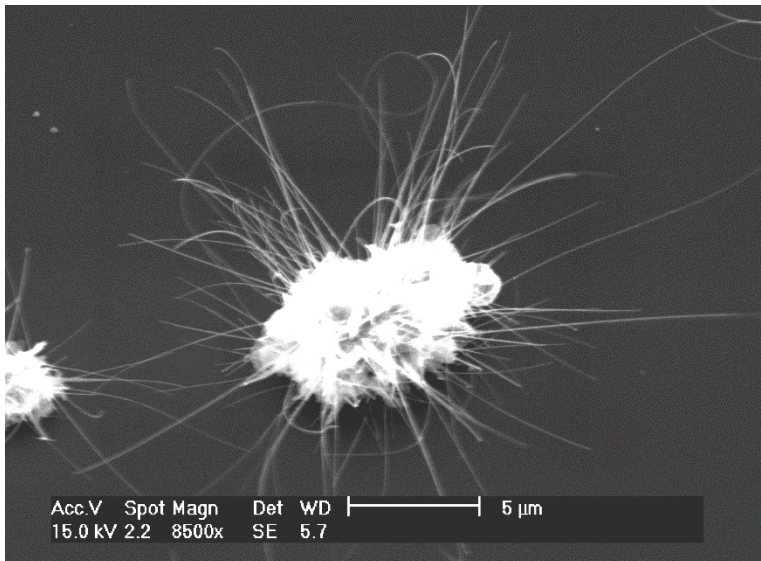
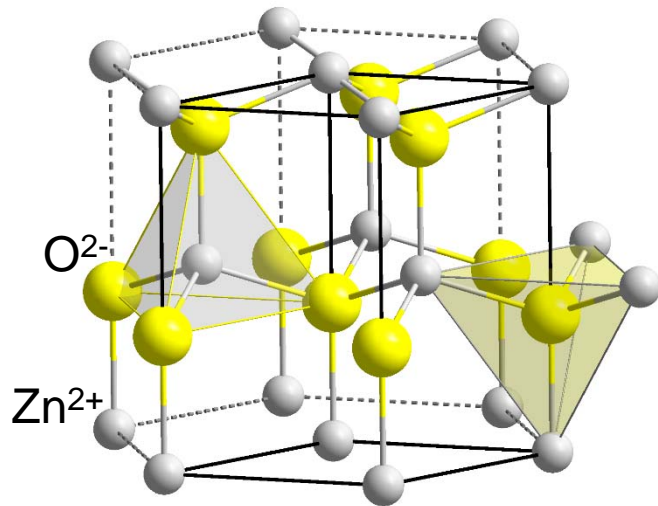


Institut für Materialwissenschaft -
Functional Nanomaterials

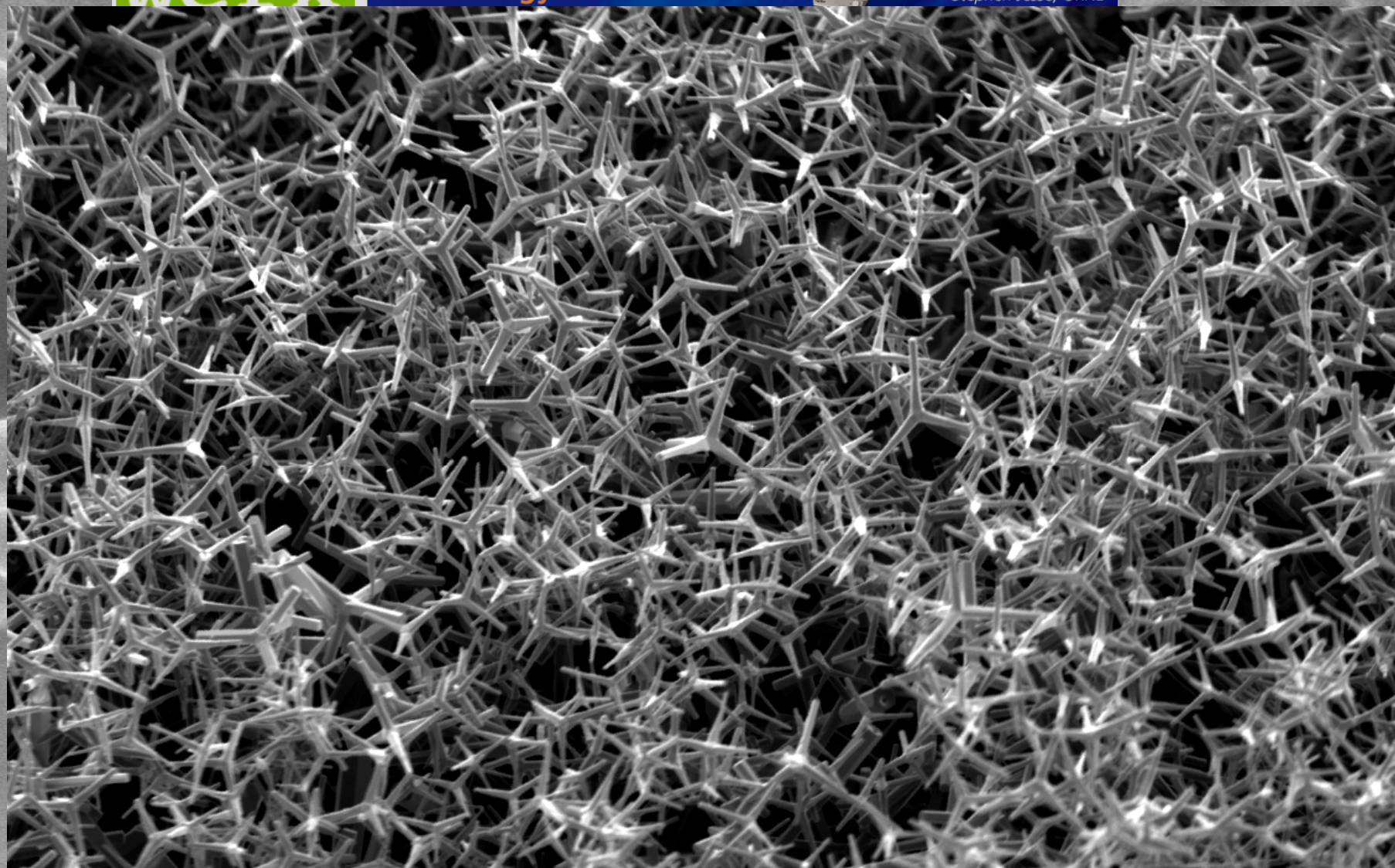
- Flame Transport Synthesis for ZnO & SnO₂
- Cytotoxicity
- Antiviral activities of semiconductors
- Into pharmacy and therapy ...



Example for a II-VI semiconductor: ZnO



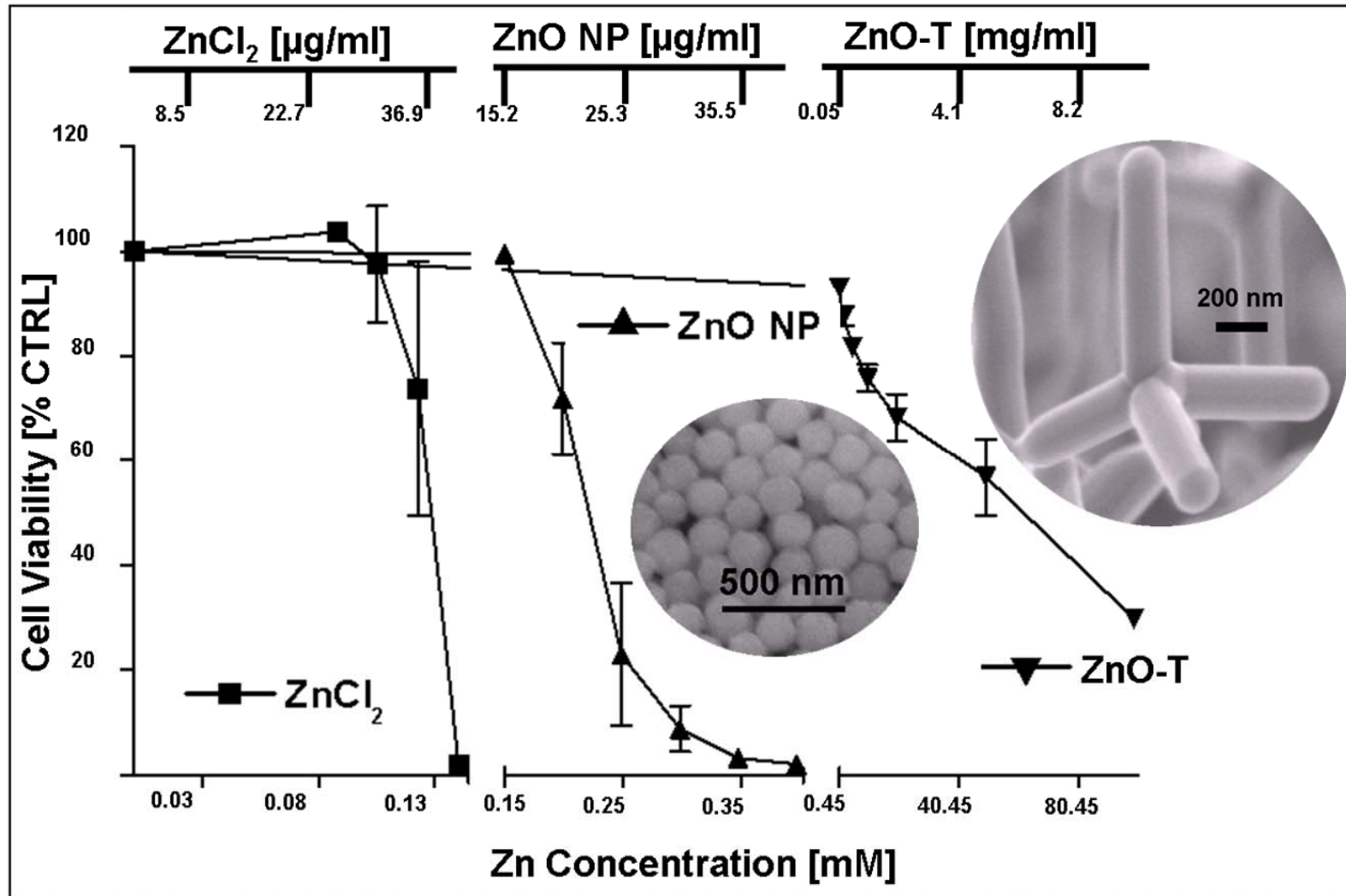
- Transparent, hexagonal crystals
- Micro crystals: White powder
- White pigment for wall paint
- Medical use due to antiseptic effects:
- Dental treatment (root channel)
- Treated as biomaterial
- Transparent conducting oxide for LED, TFT, solar cells, ...
- Piezo electric
- Photocatalytic
- Nanostructures for beginners...
- ZnO in title > 12.000 papers last 3 years
- ACS nano rejects manuscripts containing ZnO
- Perfect for overstuffed talk



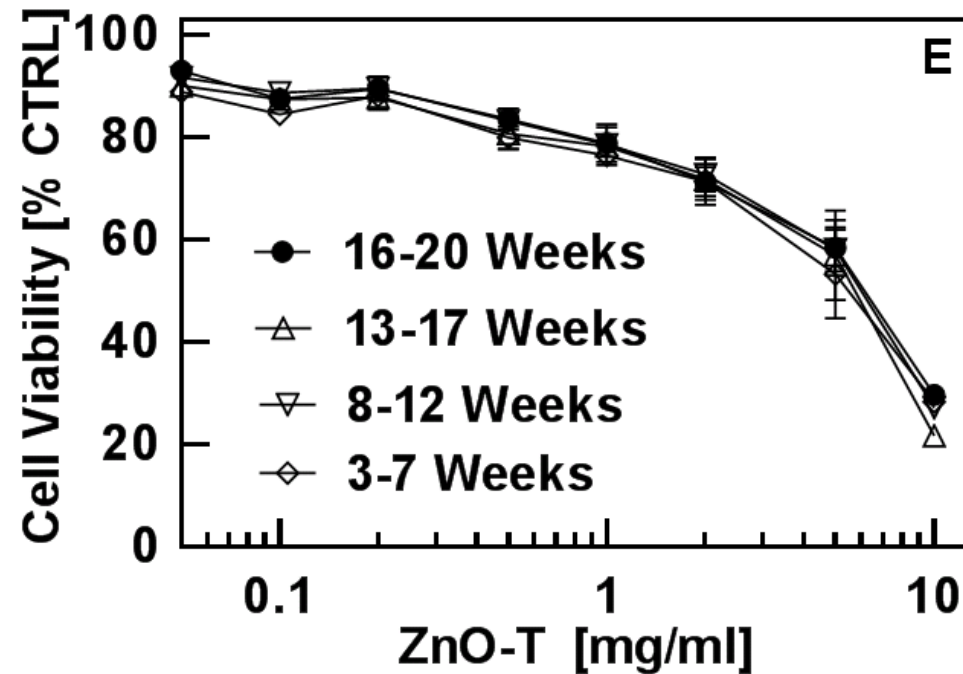
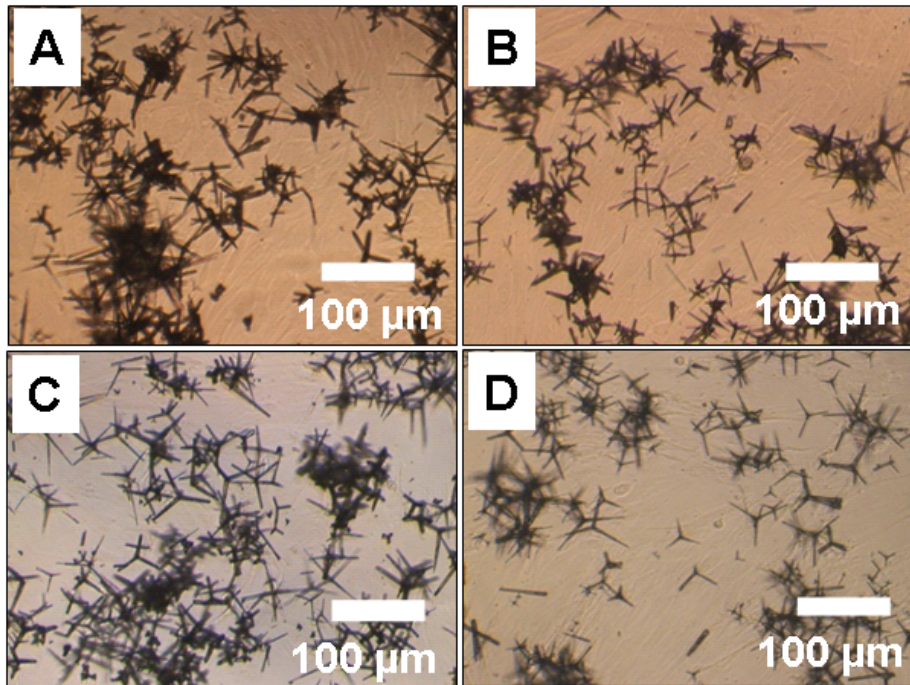
Acc.V Spot Magn Det WD

100 μ m





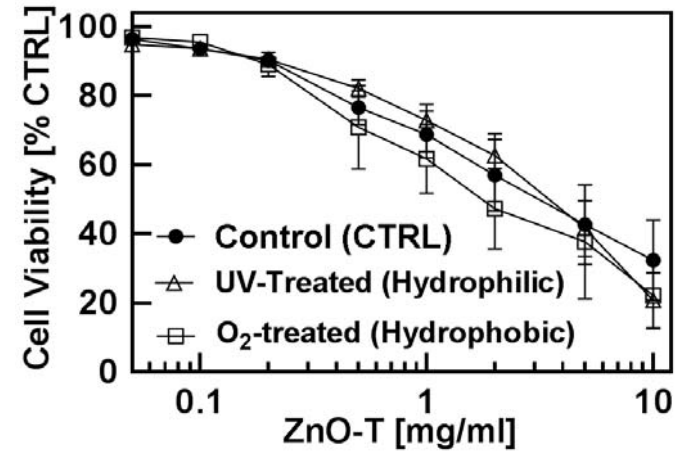
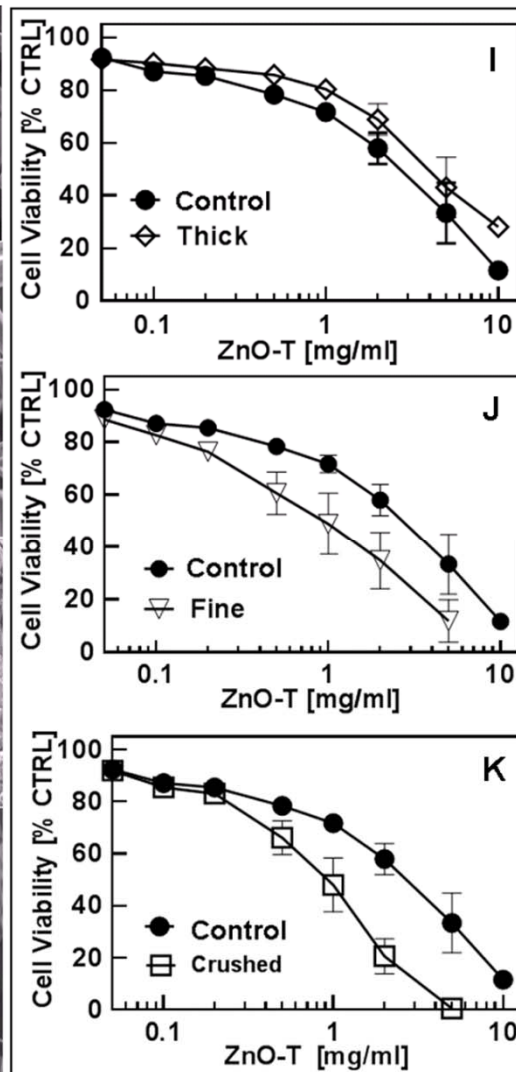
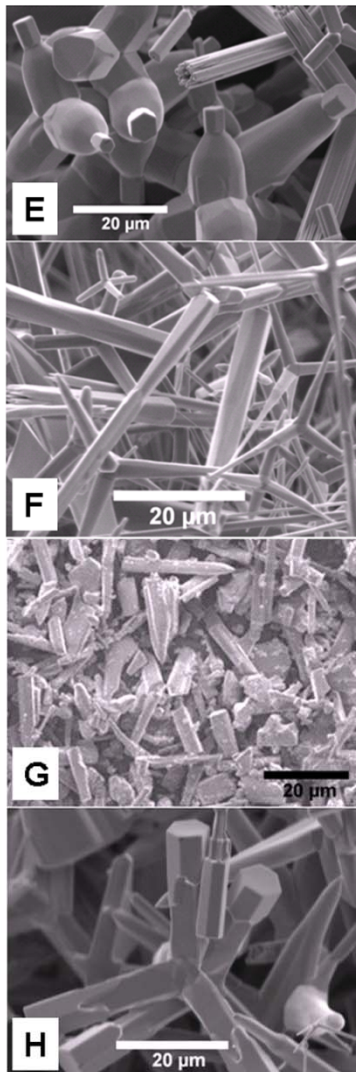
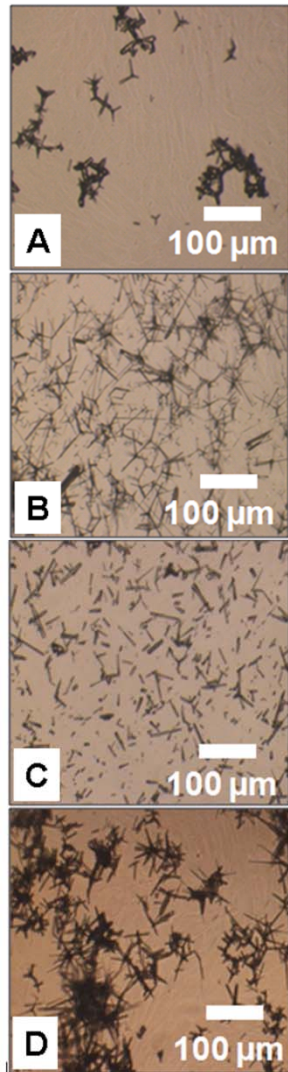
• in general, very low toxicity...



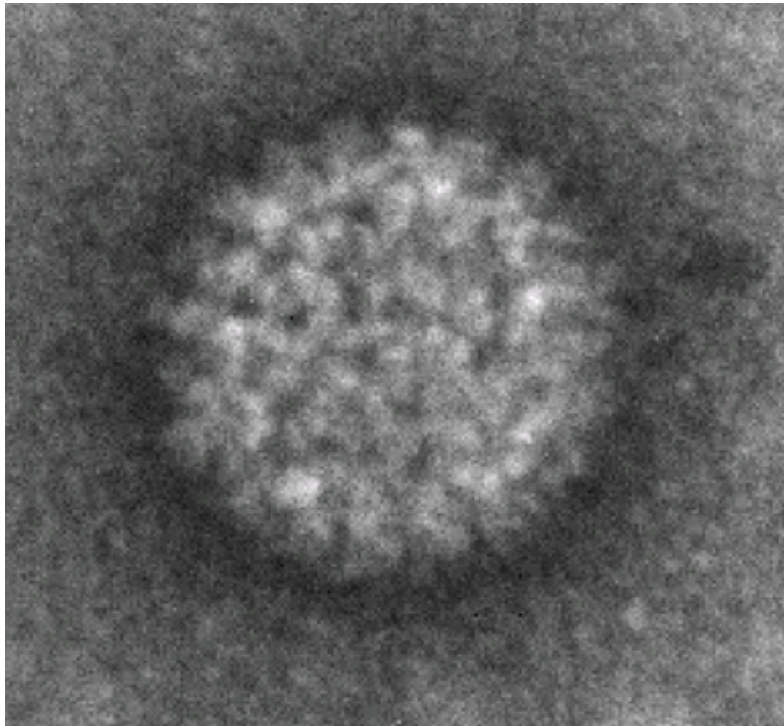
Morphology (A–D) and cytotoxicity (E) of ZnO-T structures synthesized at different dates.

- reproducible (often difficult with ZnO)
- oxygen vacancies change under ambient conditions
- normal human dermal fibroblasts (NHDF), MTT assay

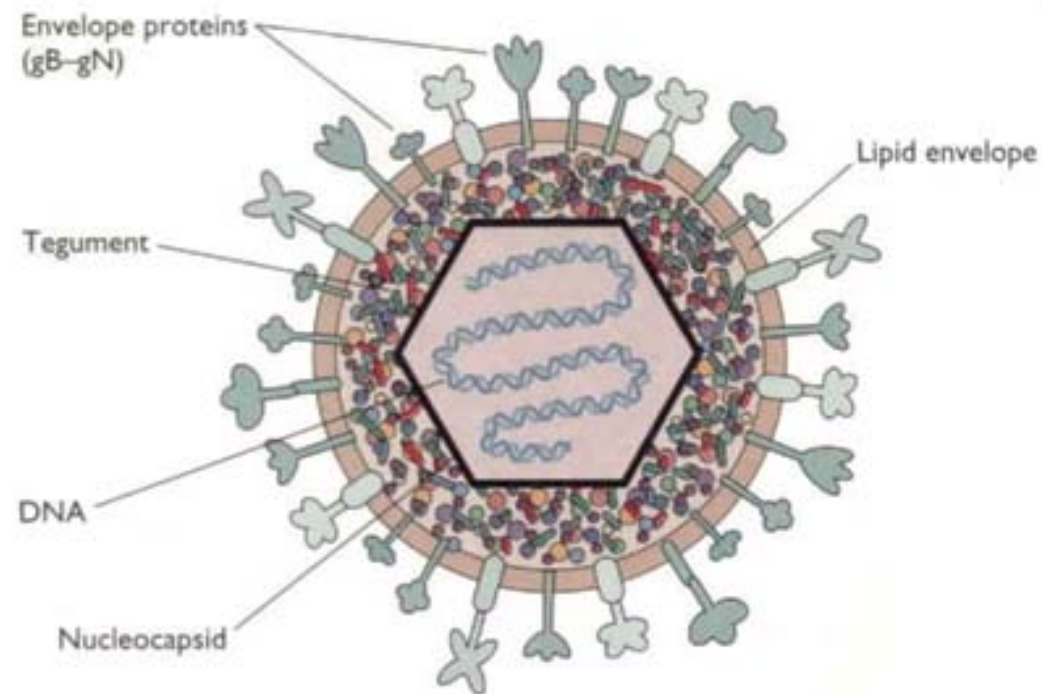
Zinkoxid and Cells: cytotoxicity...



- Geometry has influence
- surface treatment shows tendency
- Cell density shows an effect



Transmission electron microscopy
of a Virion



Herpes Virus (HSV-1)

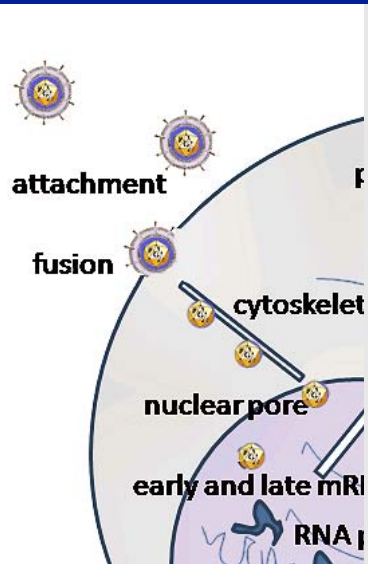
Virus = DNA / RNA program code

Viral particle (virion) = Virus with shell for traveling through the human

HSV 2: 536 million infected people

(Tronstein et al. The Journal of the American Medical Association 305, (2011) 1441)

How to exist as virus? HSV-1



[Journal home](#) > [Archive](#) > [Review](#) > [Full text](#) > Figure 1

FIGURE 1 | Herpesvirus entry.

FROM THE FOLLOWING ARTICLE:

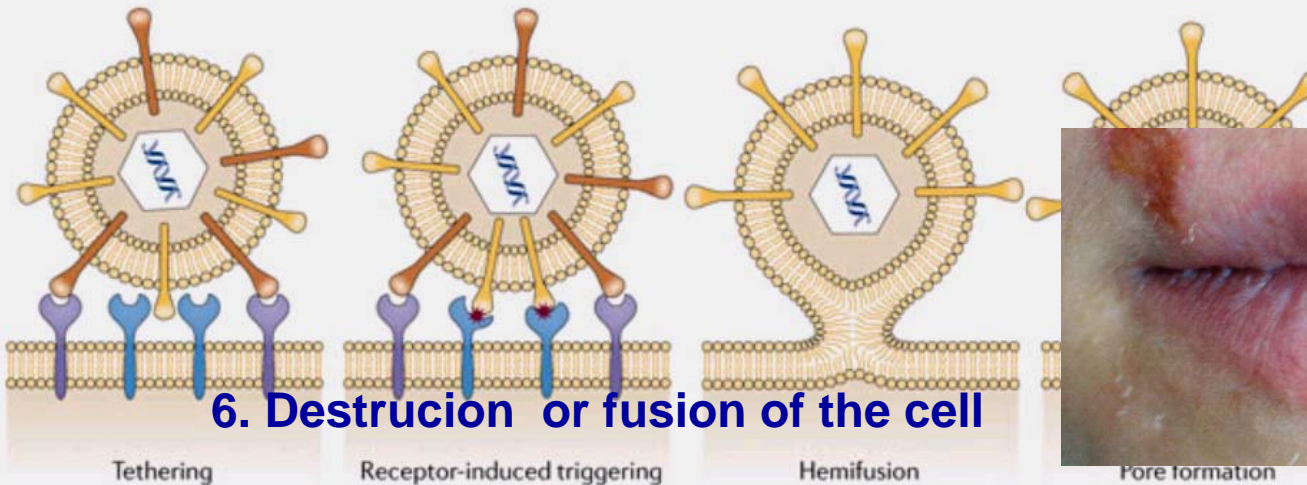
Fusing structure and function: a structural view of the herpesvirus entry machinery

Sarah A. Connolly, Julia O. Jackson, Theodore S. Jardetzky & Richard Longnecker

Nature Reviews Microbiology **9**, 369-381 (May 2011)

Binding to the host cell

Fusion with the host cell membrane



6. Destruction or fusion of the cell



as the cell

strates the cell core

ram will be started

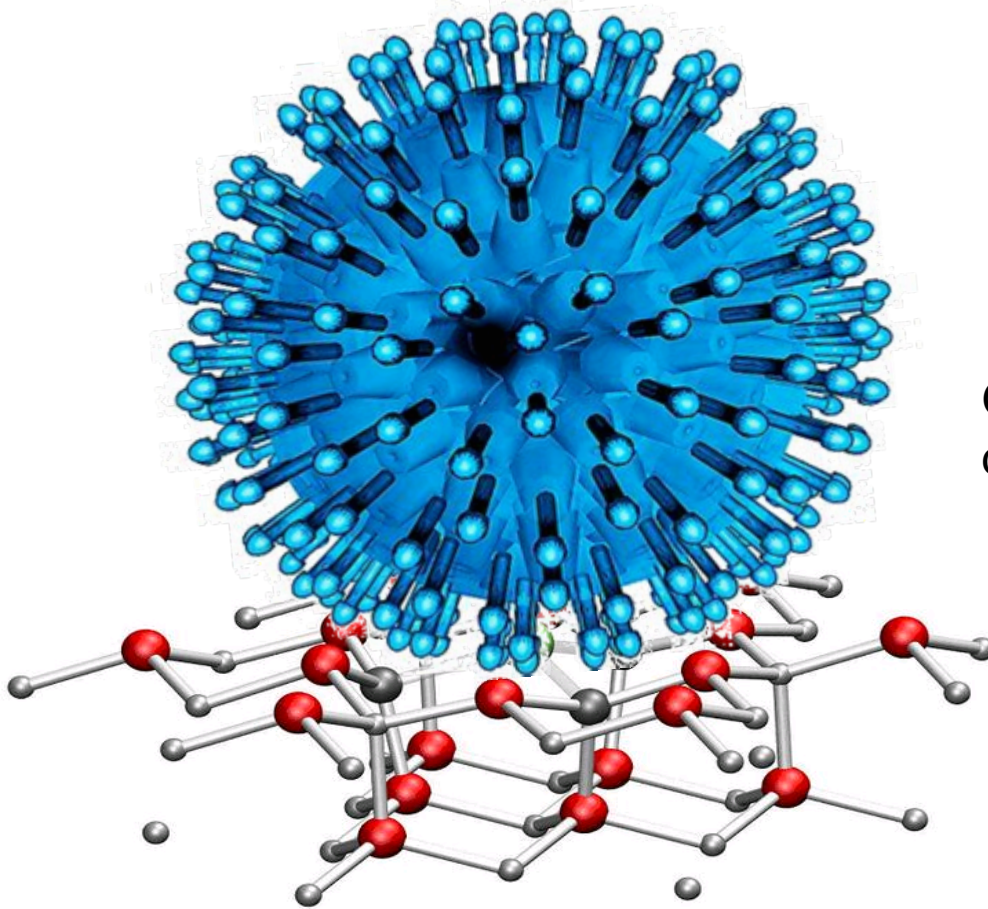
the tegument

its

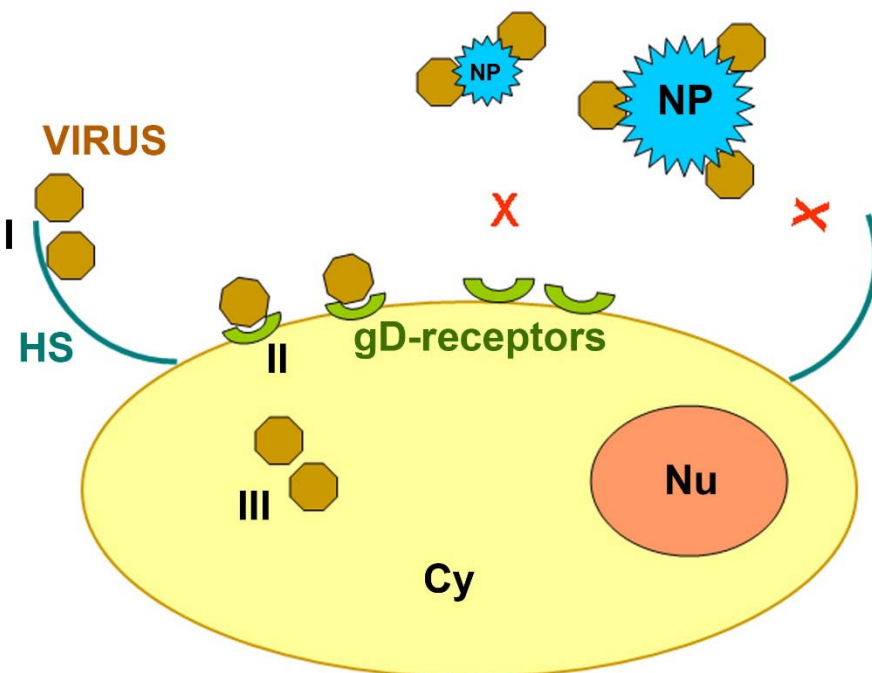
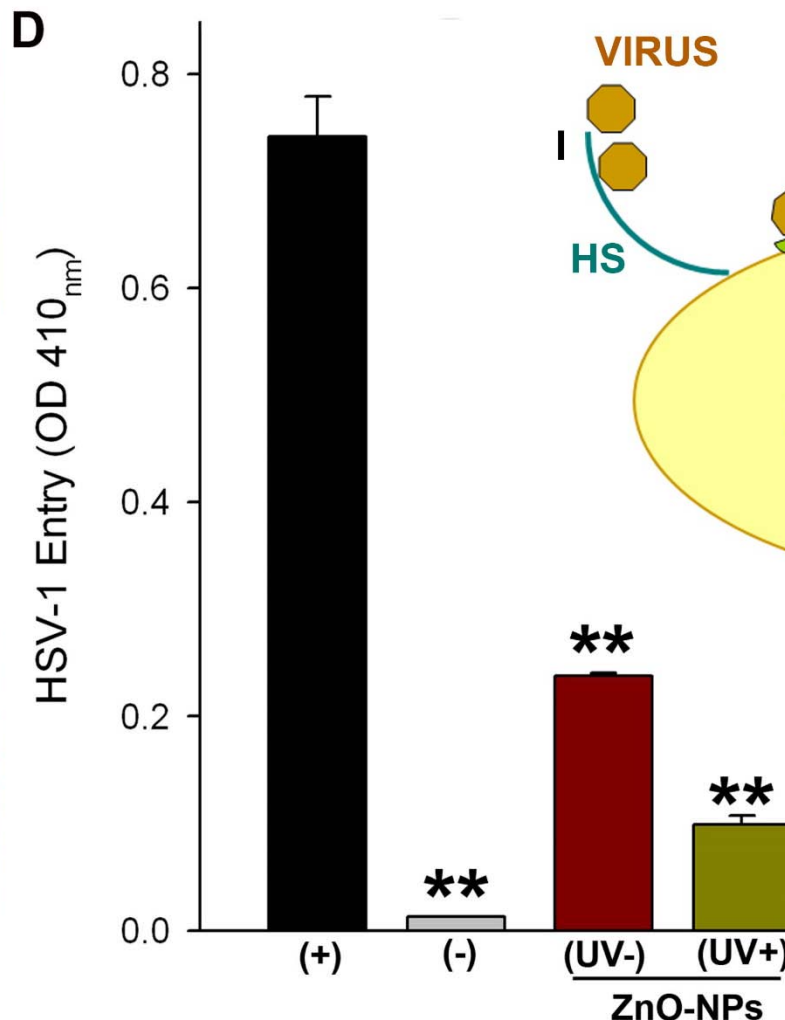
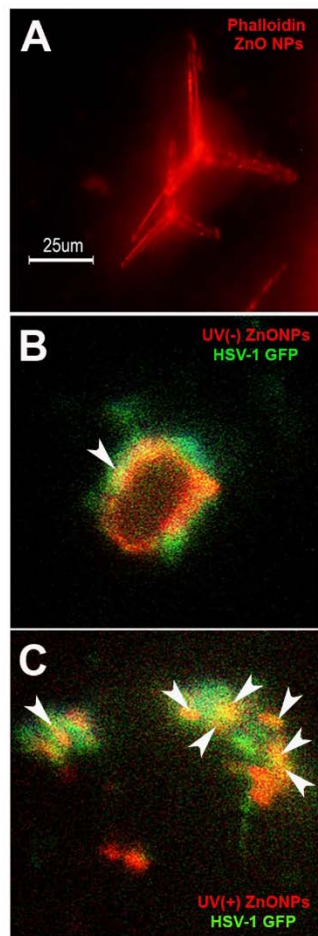
the program

ing and fabrication

on

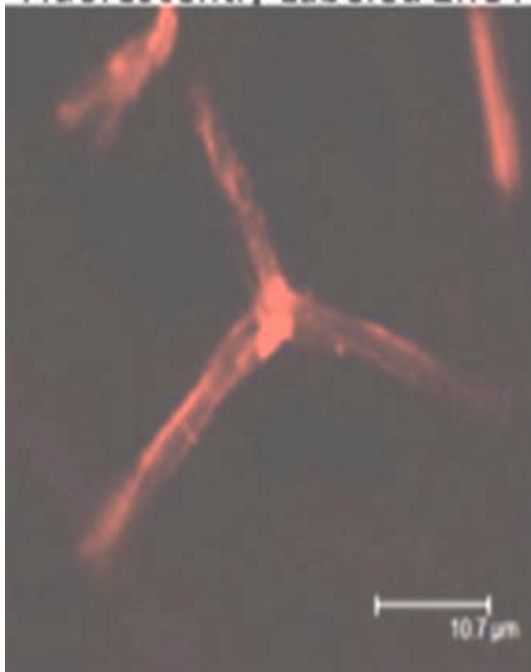


Grab the virion with the surface doping sites... (oxygen vacancies)

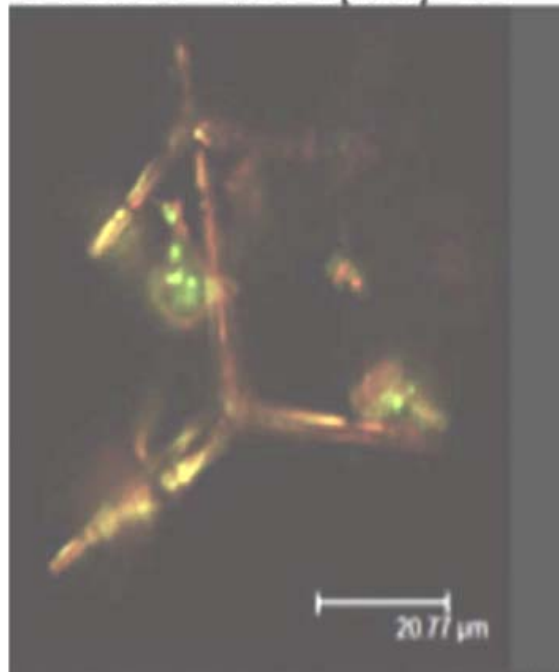


Immobilization of viruses by surface defects and specially shaped ZnO!

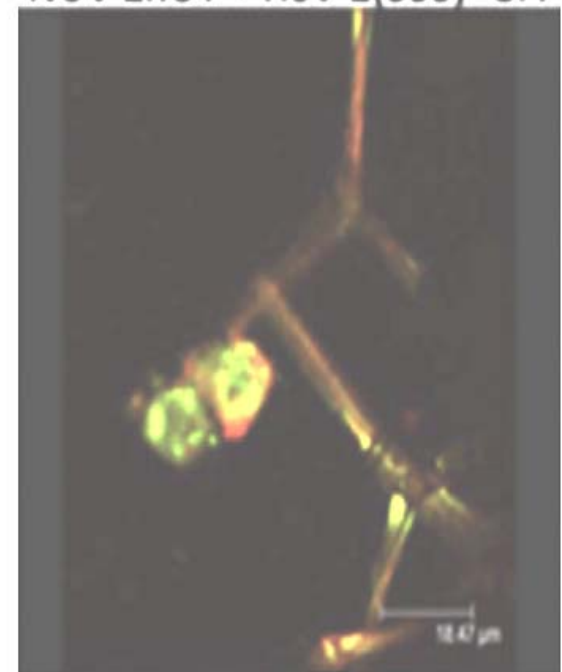
Fluorescently Labeled ZnOT



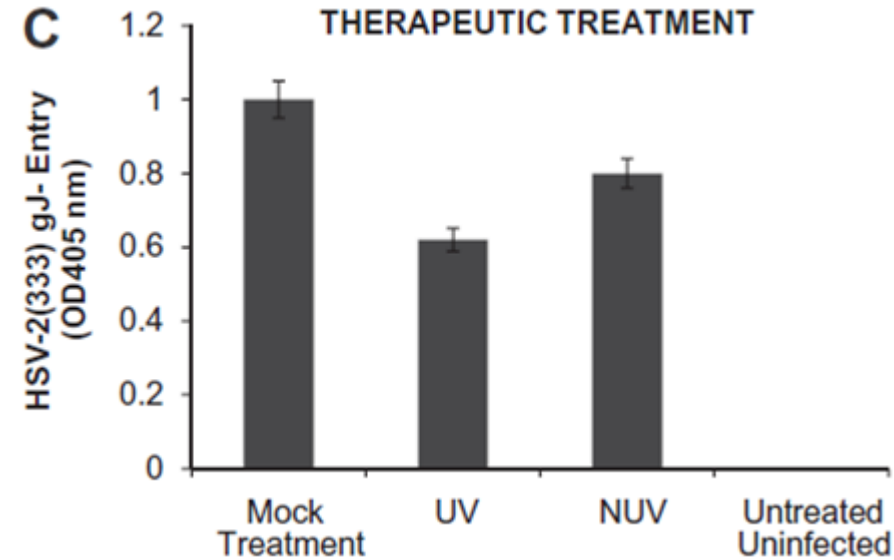
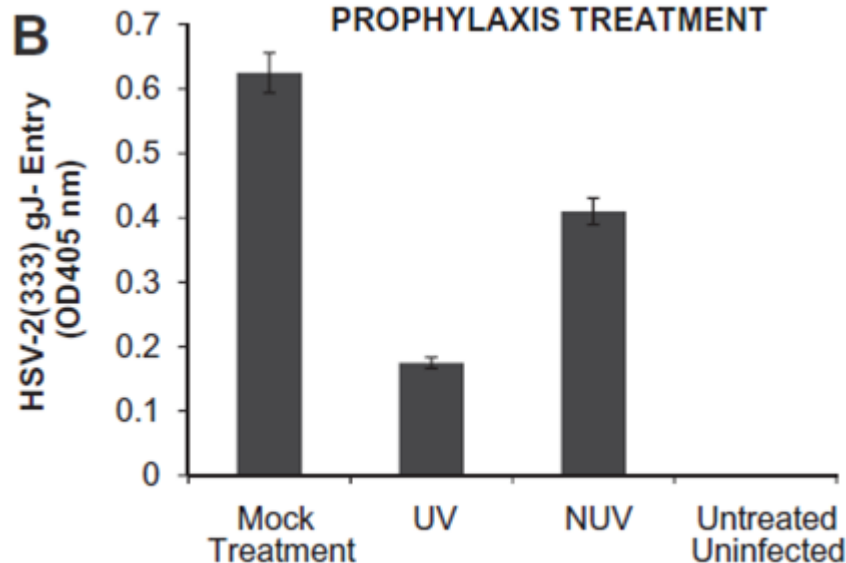
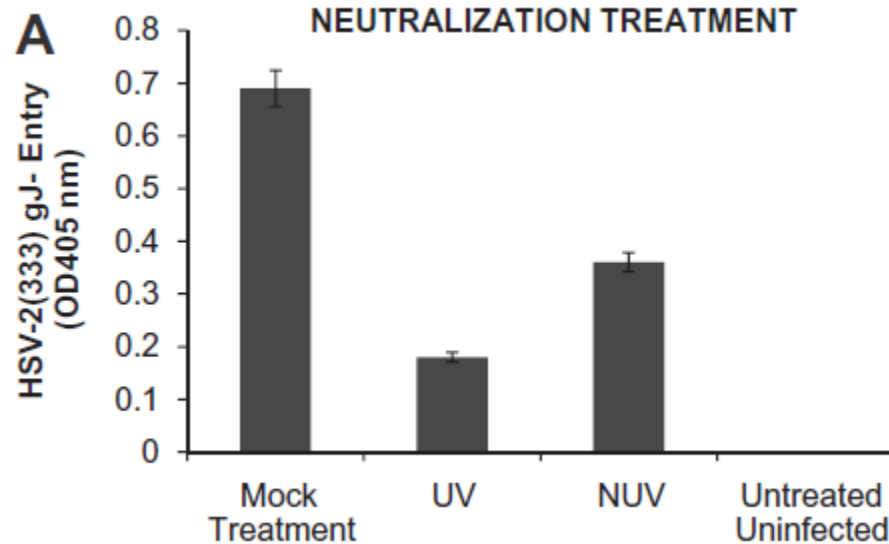
UV ZnOT + HSV-2(333) GFP



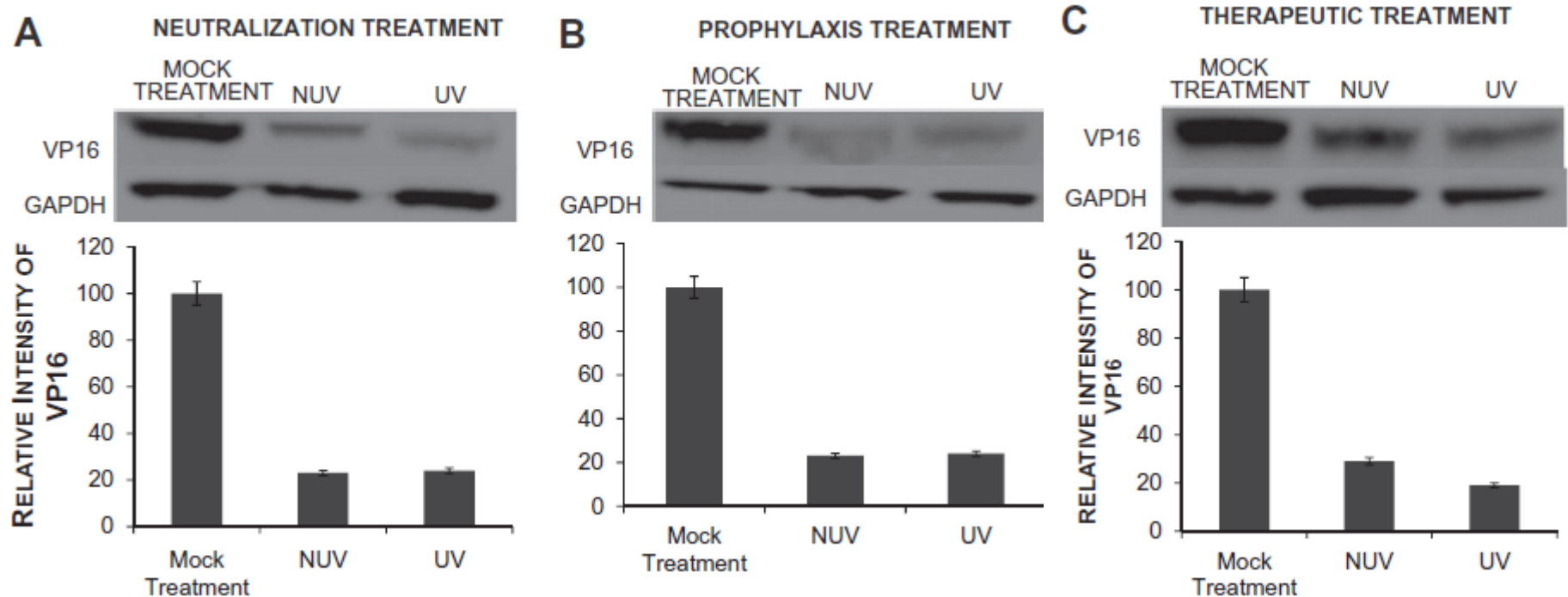
NUV ZnOT + HSV-2(333) GFP



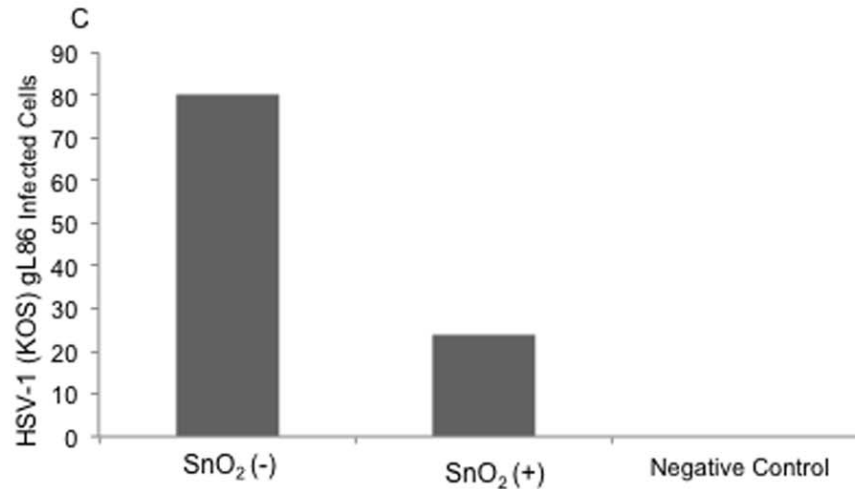
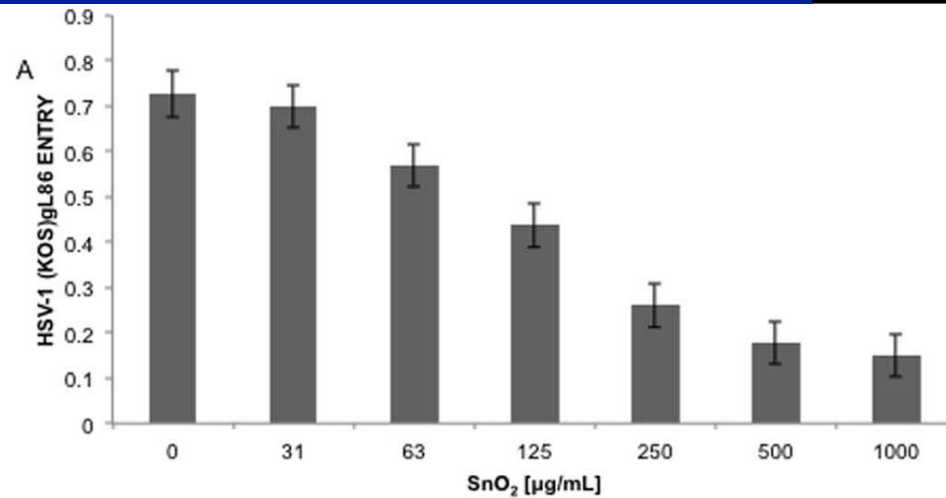
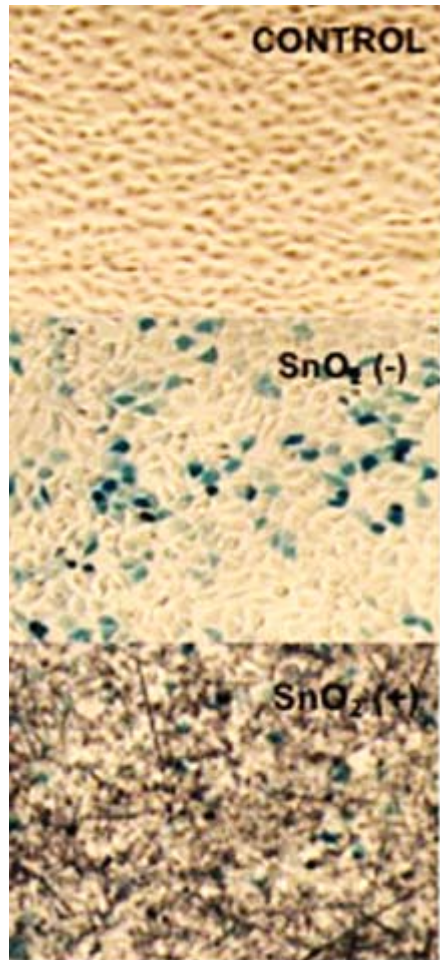
Fluorescently labeled T-ZnO binds HSV-2(333) GFP virus



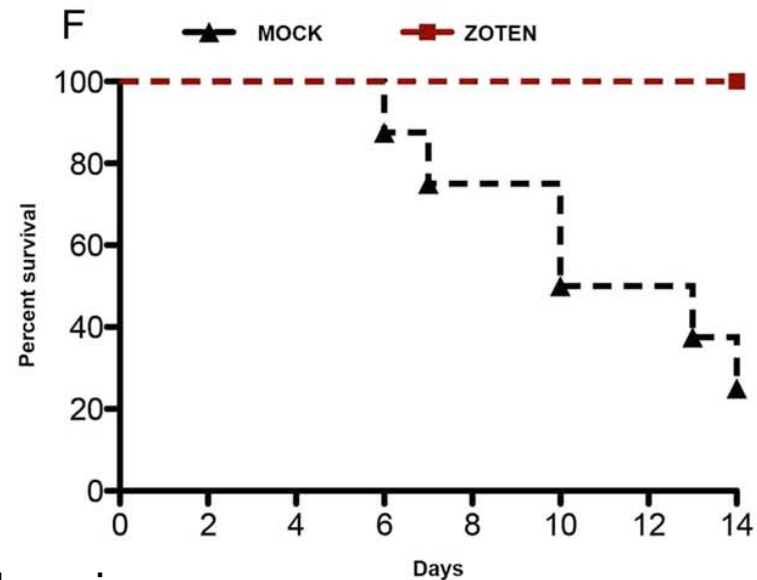
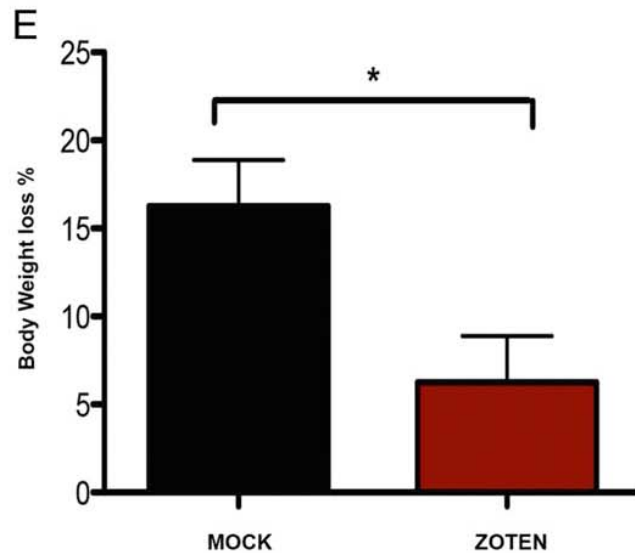
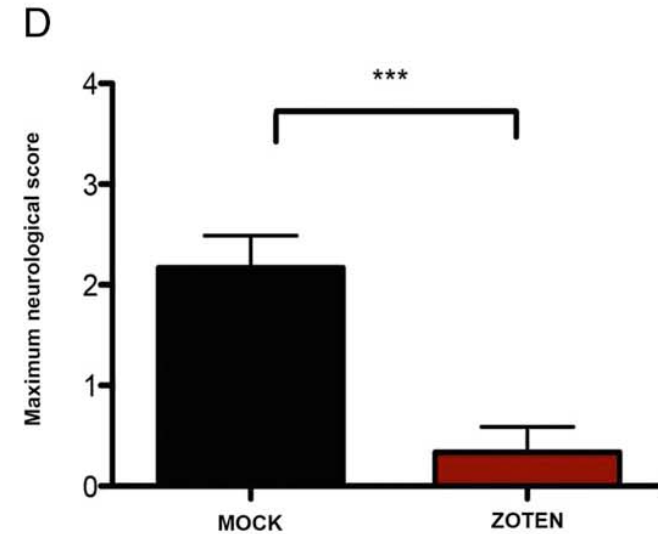
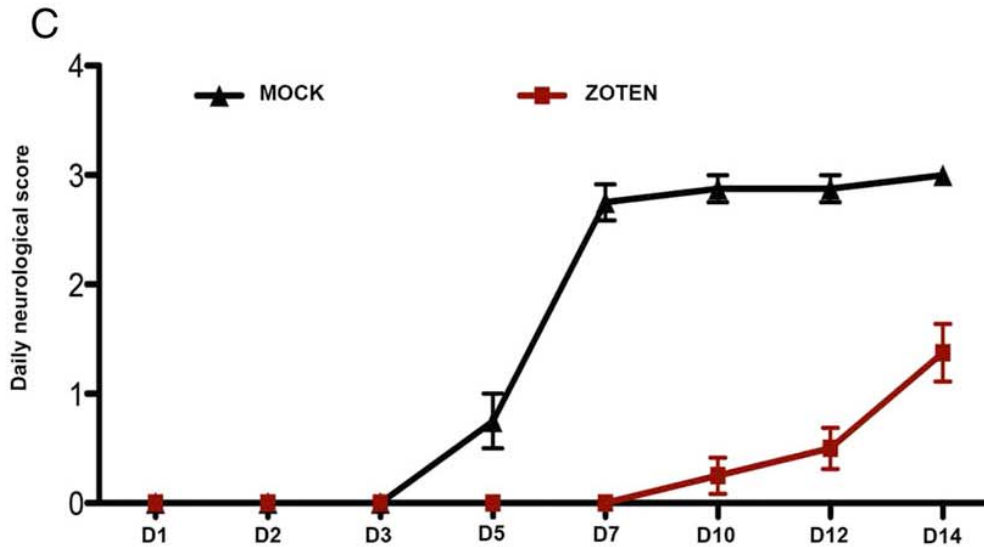
- Neutralization, prophylaxis, therapeutic treatment inhibits HSV-2 entry.
- b-galactosidase-expressing reporter virus, HSV-2(333)gJ
- UV treated (UV) or non-UV treated (NUV) ZnOTs were tested.



- Decreased internalization of HSV-2(333)
- Western blot performed to determine the effect of T-ZnO on HSV-2 internalization.
- The cell lysates were prepared at 2 h post infection and Western blots were performed.

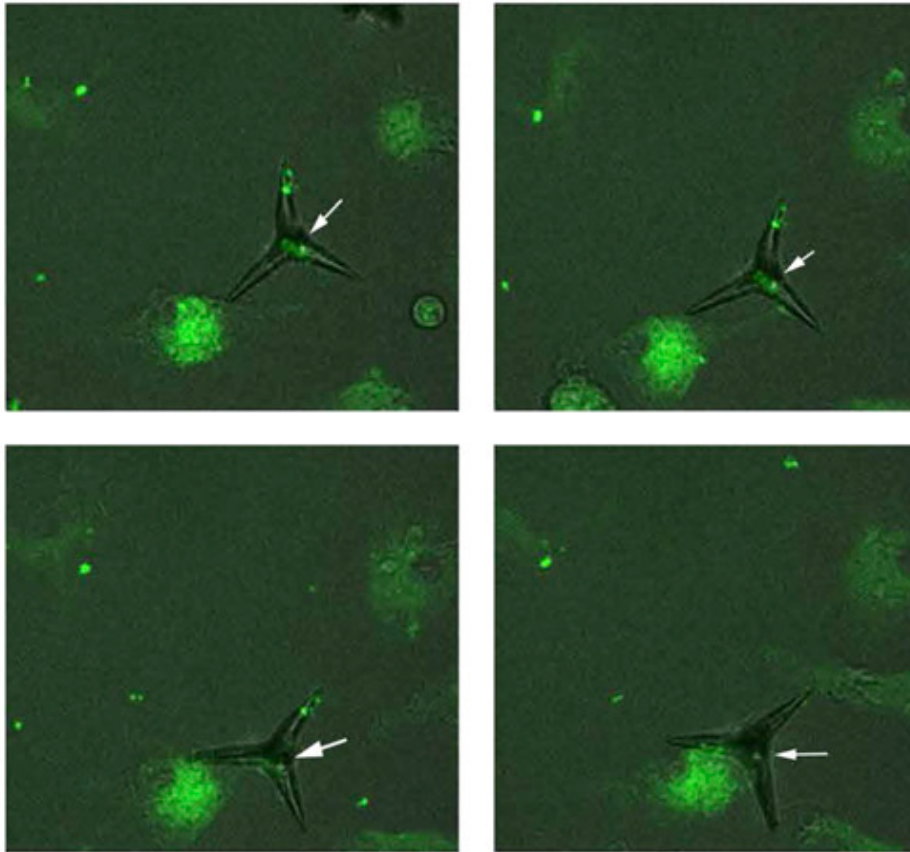


SnO₂ inhibits HSV-1 entry into HCE cells as well.

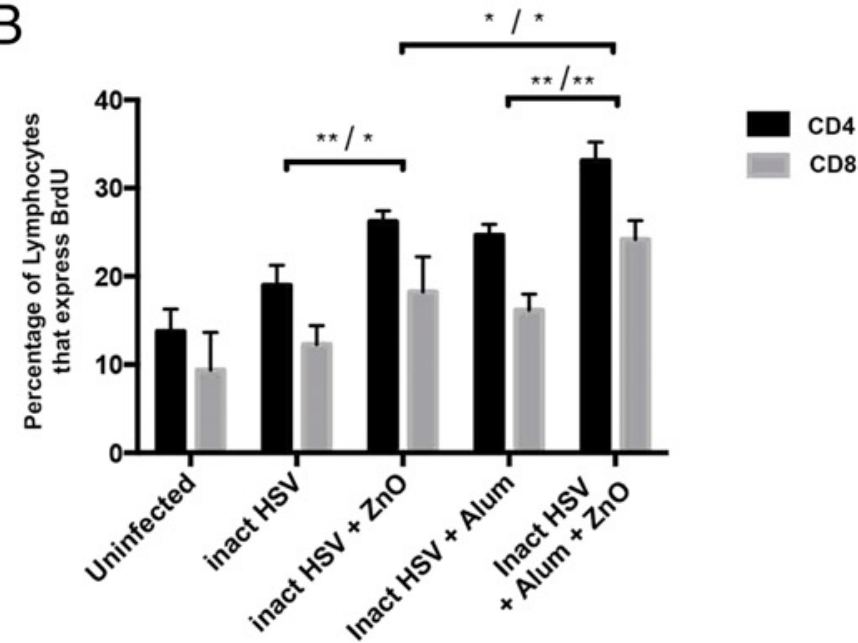


Animal study: mice

A



B



HSV-2	-	+	+	+	+
ZOTEN	-	-	+	-	+
Alum	-	-	-	+	+

CD4	13.74	18.99	26.23	24.66	33.11
CD8	9.37	12.27	18.27	16.17	24.17

Thessicar E. Antoine, Satvik Hadigal, Abraam Yakoub, Yogendra Kumar Mishra, Palash Bhattacharya, Christine Haddad, Tibor Valyi-Nagy, Rainer Adelung, Bellur S. Prabhakar, Deepak Shukla, „Intra-vaginal Zinc Oxide Tetrapod Nanoparticles as Novel Immunoprotective Agents against Genital Herpes“, Journal of Immunology 196, 4566 (2016)



Gorch-Fock-Apotheke

Antje Haase
Steenbeker Weg 33
24106 Kiel

Telefon: 0431/33 35 36
Telefax: 0431/33 72 94
E-Mail: info@gorch-fock-apotheke.de



Start | Apotheke | Vorbestellung | Leistungen | Kosmetik | Biochemie | Biochemie-Lotionen

und leben

- ber
- thilfe
- enplanung
- Check
- werte
- le und Erste Hilfe
- ative Heilkunde
- rungsmedizin
- medizin
- ose und Therapieverfahren
- ngen | Vorsorge

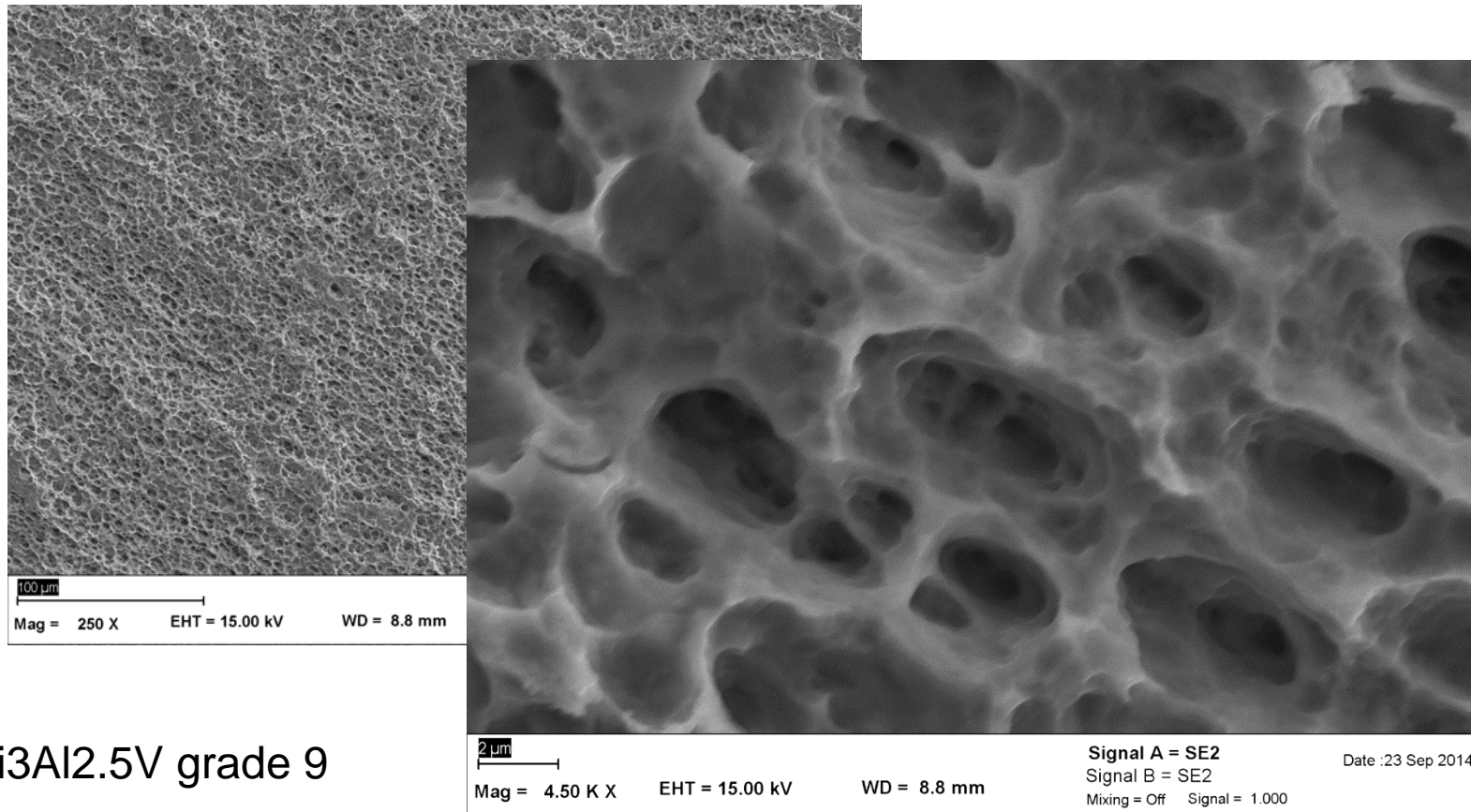
Herzlich Willkommen



Seit über 30 Jahren beraten wir Sie in der Gorch-Fock-Apotheke engagiert und kompetent in allen Arzneimittel- und Gesundheitsfragen.

- ZnO is an accepted active agent
- Pharmacists in Germany are allowed to prepare standard formulations
- Effect should not be announced...

- ZnO as approved medical device
- HPV on the way, HIV has to be tested urgently
- Probably much more semiconductors relevant for medical applications



Ti3Al2.5V grade 9

Pores (Pat. Pend.) with under cuts for mechanical interlocking

€ S.-H. &

DFG: SFB 677, SFB 1261, FOR 2093
BMBF

BMW (DKL-WEA, DLC4marin, WWZ)
AvH

EU: Graphene Flagship/Flag Era

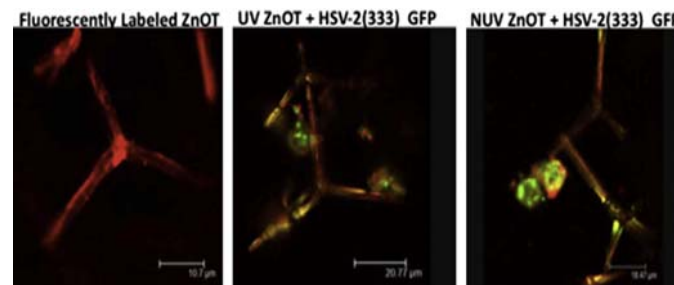


New techniques enable
multifunctional & intelligent medical
materials

Thank You!



- (Oxid)-Semiconductors have shape dependant variaty in cytotoxicity
- (Oxid)-Semiconductors can be effective against viruses by immobilization
- More studies important: e.g. HPV,HIV,...?
- Is there therapy possible beyond patented formulations? New semiconductor pharma?



Oxide Semiconductors as antiviral agents: Herpes therapy from Lab to Pharmacy

Herpes simplex viruses (HSV) establish lifelong infections, and the virus cannot yet be eradicated from the body. The HSV-2 type is one of the most frequent sexually transmitted infections worldwide with global estimates of 536 million infected people and an annual incidence of 23.6 million cases[1] . In this presentation, the antiviral potential of oxide semiconductors as antiviral agents will be discussed [2-4]. Oxygen vacancies are employed as adhesion sites of glycoproteins on the surface of the capsid and bind the virus effectively. It will be shown that oxide semiconductors can have a prophylactic, therapeutic as well as neutralizing effect. It will be explained how irradiation of UV-light can even increase the antiviral activity. The cytotoxic effects [4] of the micro-crystalline material is discussed as well as how the material could be brought from lab into pharmacies.

[1] E. Tronstein, C. Johnston, M.L. Huang, S. Selke, A. Magaret, T. Warren, L. Corey, A. Wald
"Genital shedding of herpes simplex virus among symptomatic and asymptomatic persons with HSV-2 infection"
The Journal of the American Medical Association, 305 (2011), pp. 1441

[2] Y. K. Mishra, R. Adelung, C. Röhl, D. Shukla, F. Spors & V. Tiwari
"Virostatic potential of micro--nano filopodia-like ZnO structures against herpes simplex virus-1"
Antiviral research 92 305-312 (2011)

[3] T. E. Antoine, Y. K. Mishra, J. Trigilio, V. Tiwari, R. Adelung & D. Shukla
"Prophylactic, therapeutic and neutralizing effects of zinc oxide tetrapod structures against herpes simplex virus type-2 infection"
Antiviral research 96 363-375 (2012)

[4] J. Trigilio, T. E. Antoine, I. Paulowicz, Y. K. Mishra, R. Adelung & D. Shukla
"Tin oxide nanowires suppress herpes simplex virus-1 entry and cell-to-cell membrane fusion"
PloS one 7 e48147 (2012)

[5] H. Papavlassopoulos, Y. K. Mishra, S. Kaps, I. Paulowicz, R. Abdelaziz, M. Elbahri, E. Maser, R. Adelung & C. Röhl
"Toxicity of functional nano-micro zinc oxide tetrapods: Impact of cell culture conditions, cellular age and material properties"
PloS one 9 e84983 (2014)

