

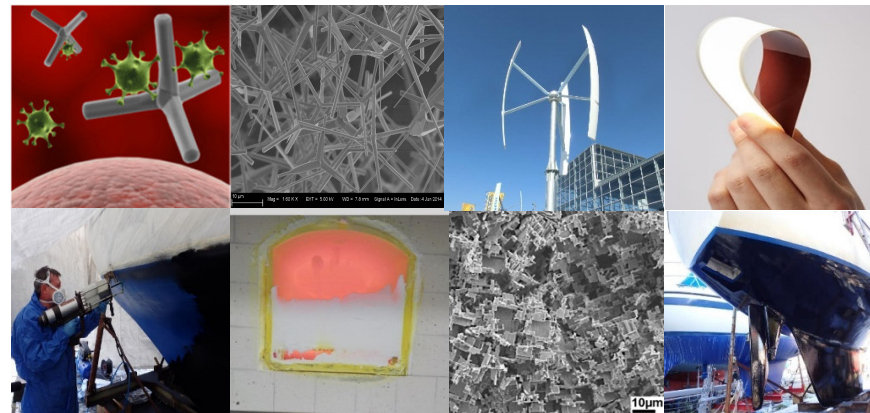
Transfer of processes from development to production

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Contents

- 1. Technology transfer: concept, stages and criteria**
- 2. Example of technology transfer based on ZnO product**
- 3. Definition and importance of Good Manufacturing Practices (GMP)**

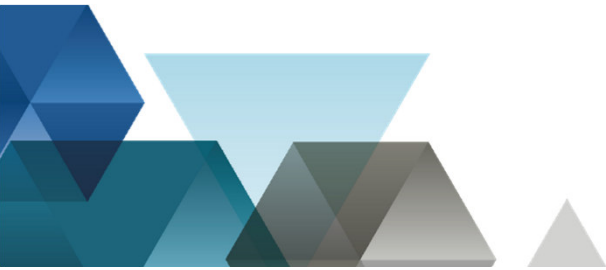
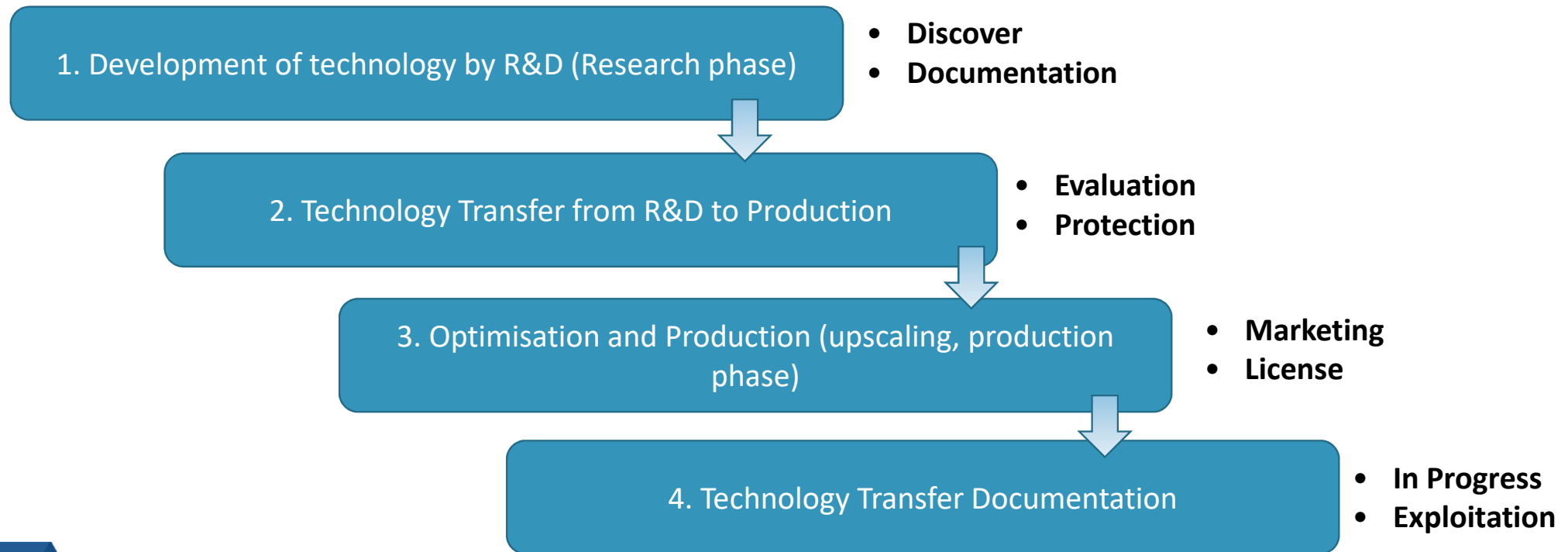
Definition

Technology transfer is the transfer of skills, technology and knowledge between organizations.

Its aim is the continuous transfer of technological advances that promotes development.



Stages involved in Technology Transfer process



1. Development of technology by R&D (Research phase)

Decision criteria for technology transfer

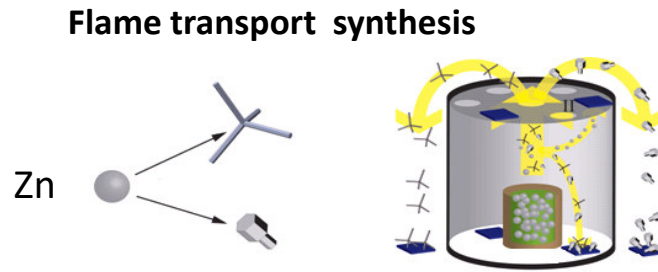


Technologietransfer

1. Development of technology by R&D (Research phase)

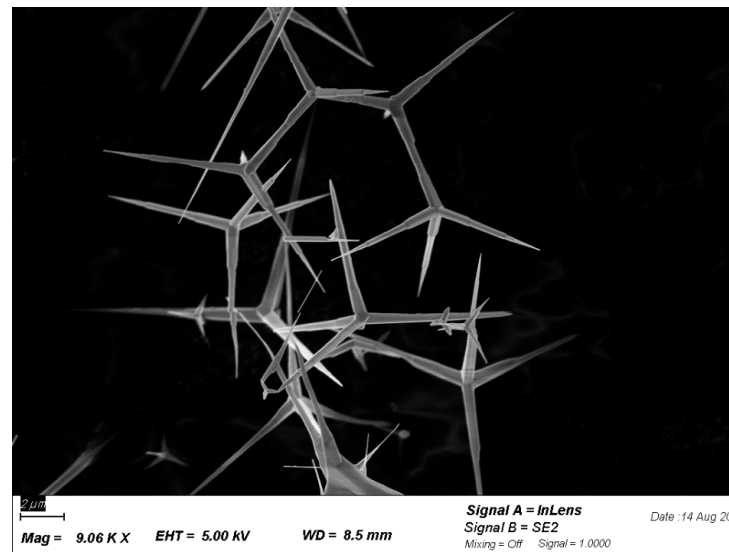
Example: t - ZnO

Used process:



Process developed from Functional Nanomaterials Group, Institute for Materials Science, Kiel University

Particle & Particle Systems Characterization [Volume 30, Issue 9](#), pages 775–783, September 2013



1. Development of technology by R&D (Research phase)

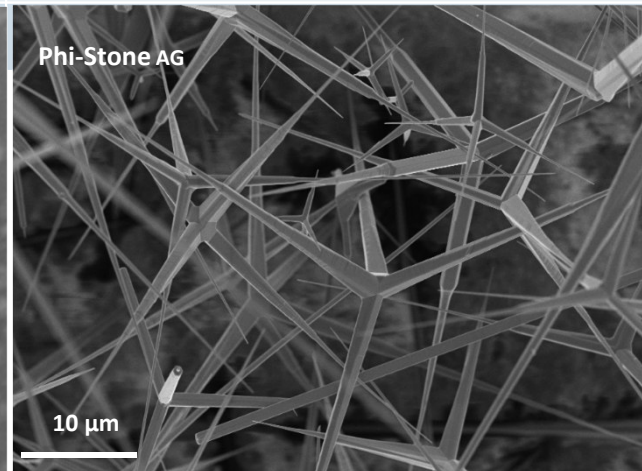
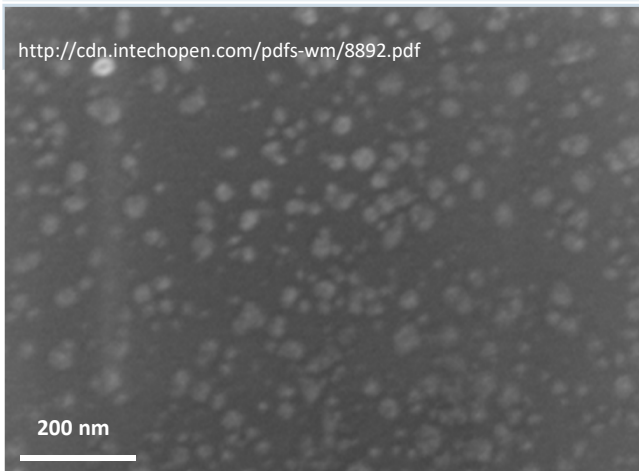
Comparison of commercial ZnO and t-ZnO

New Regulations?



Yes!

Standart ZnO	t – ZnO CSP
Presence of foreign atoms (metals, <2 %)	Higher purity due to synthesis (recrystallisation process)
Limited biocompatibility (may penetrate skin)	biocompatible (can be degraded by cells) http://www.nanoscience.gatech.edu/paper/2009/j_phys_chem_c_20114.pdf
Large contact area	Large contact area
Nanoparticles	Microparticles (nanostructured), network → easier, safer to handle



1. Development of technology by R&D (Research phase)

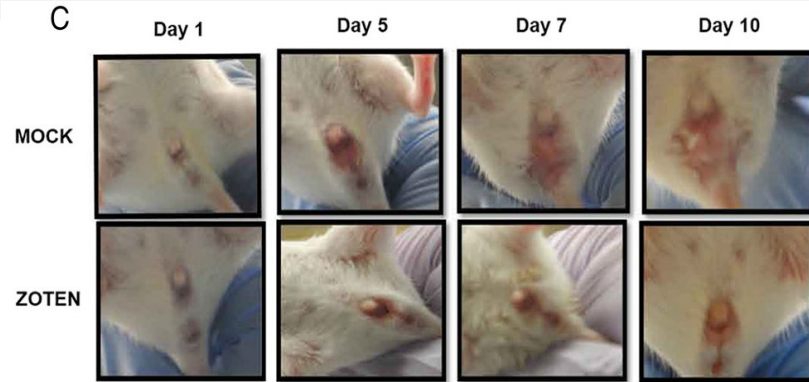
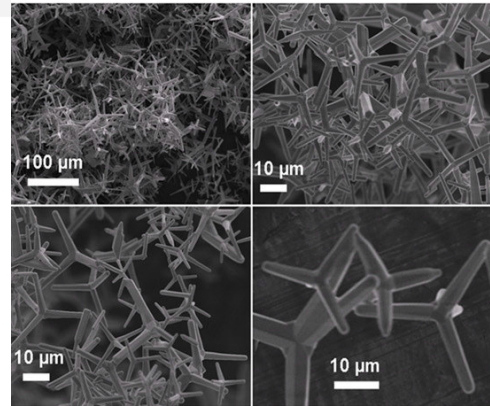
Kiel University investigation & results

In-vivo animal studies for role of t-ZnO against genital herpes virus

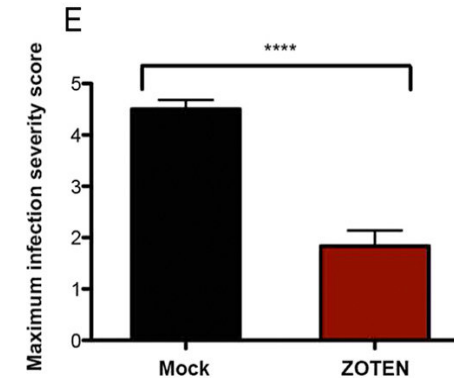
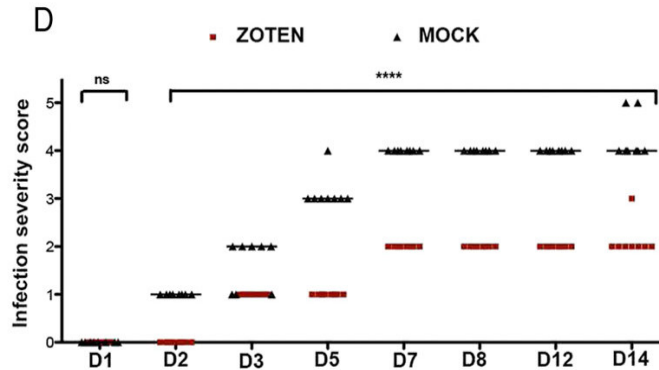
Disruptive Technology?



Yes!



The wound healing was much faster



The use of t-ZnO reduced the development of chronic infection
The t-ZnO-treated animals survived longer

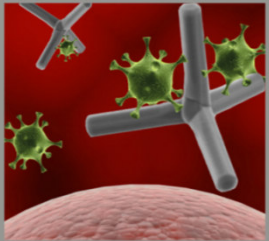
www.jimmunol.org/cgi/doi/10.4049/jimmunol.1502373



1. Development of technology by R&D (Research phase)

Technology antiviral zinc-oxide

Production
of t-ZnO



**Disruptive
Technology?**

- Herpes-Cremes fight against viruses, t-ZnO makes viruses visible for the immune system. It can fight against the virus and elongate the time until the next outbreak/prevent the next outbreak.

**Market-
potential?**

- **1 of 10 Menschen** suffer from recurring oral herpes
- Herpes simplex infektionen are the most often sexually transmitted diseases, worldwide **>500 Million affected people**

**Price/
Performance?**

- Synthesis in principle not expensive
- **!GMP-Certificate necessary!**

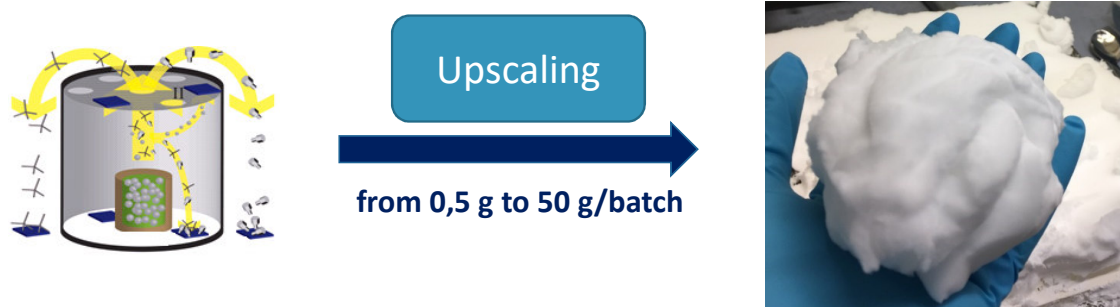


Technology transfer



2. Technology Transfer from R&D to Production (Upscaling)

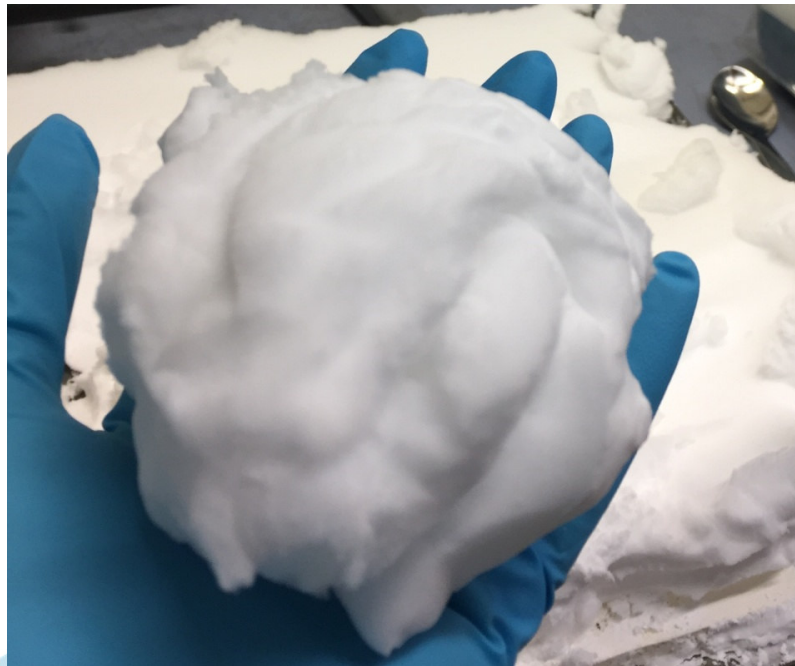
Upscaling of the patented flame-transport synthesis



3. Optimisation and Production (production phase)

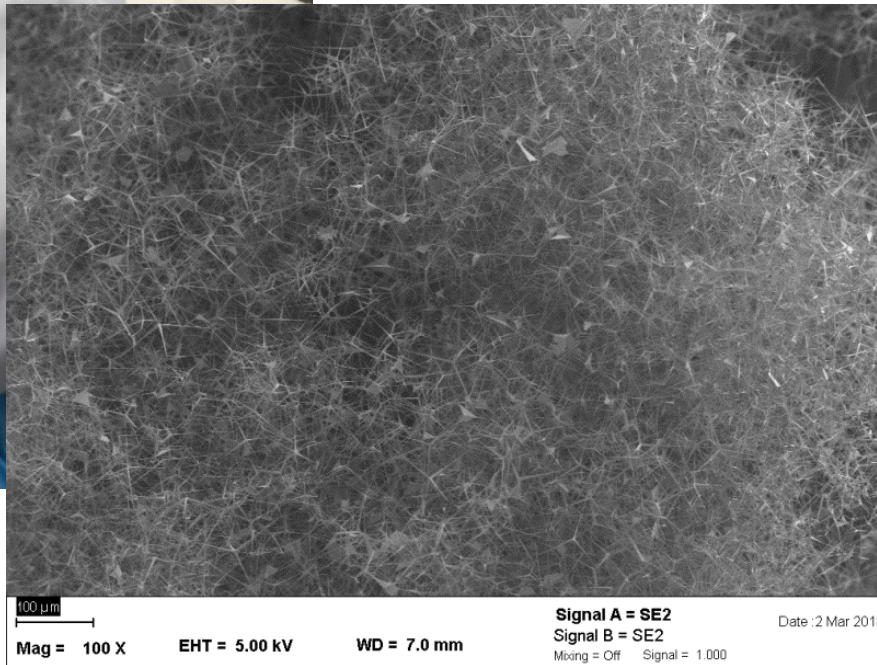
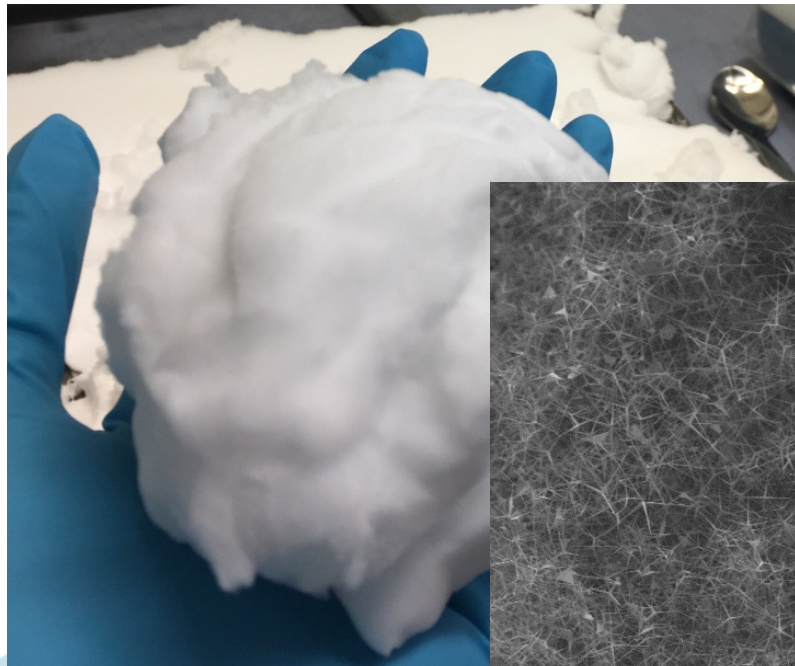
Product: t-ZnO

Brand:  CSP[®]



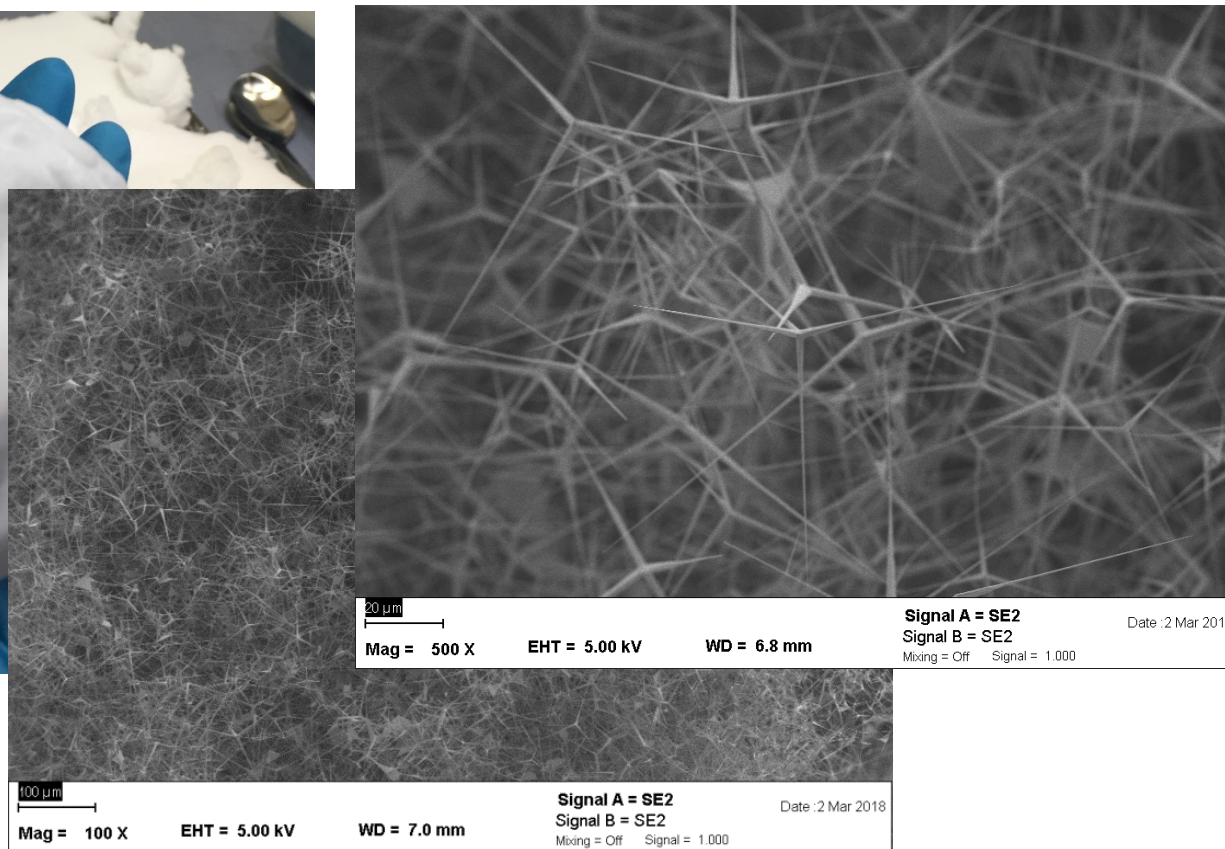
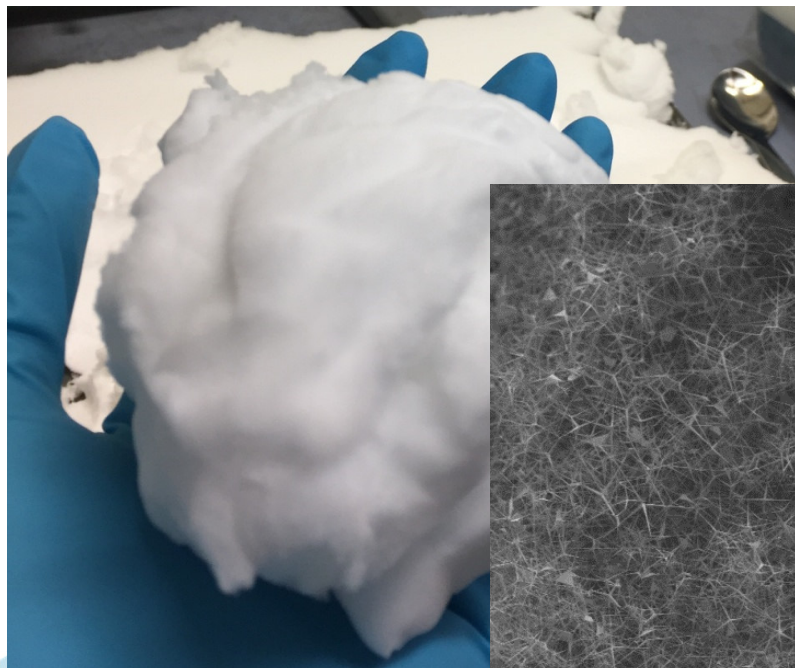
3. Optimisation and Production (production phase)

Product: t-ZnO



3. Optimisation and Production (production phase)

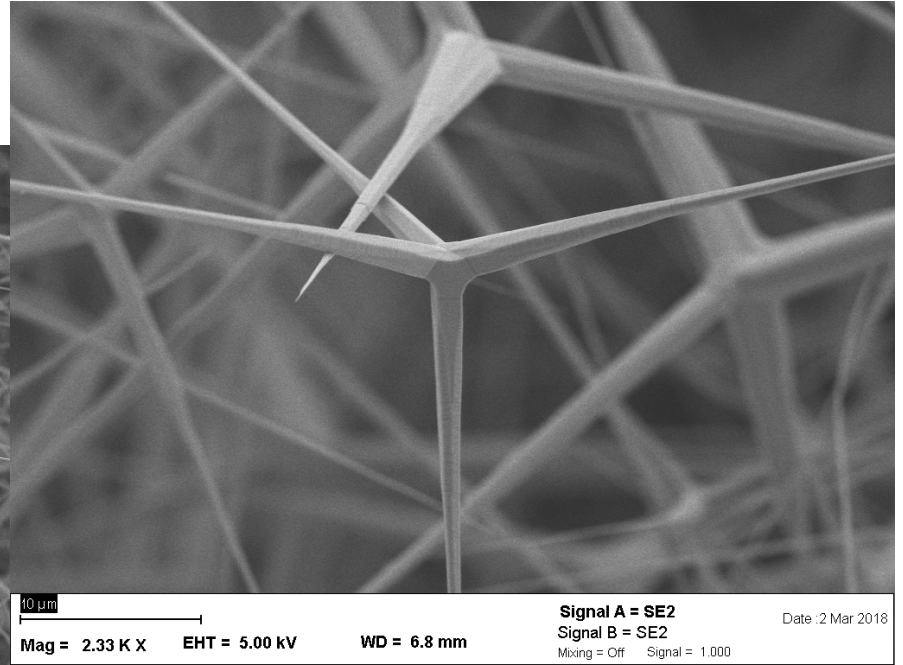
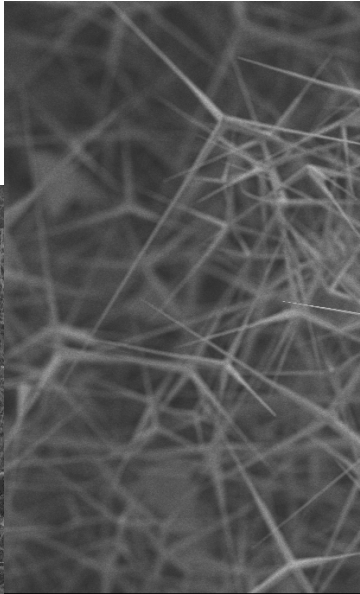
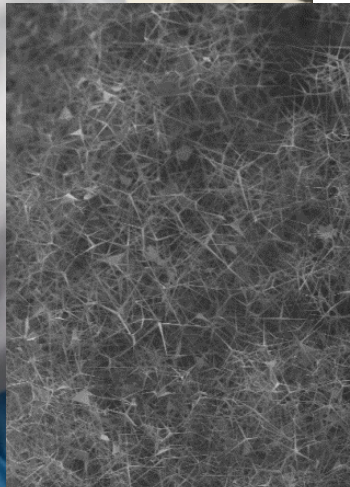
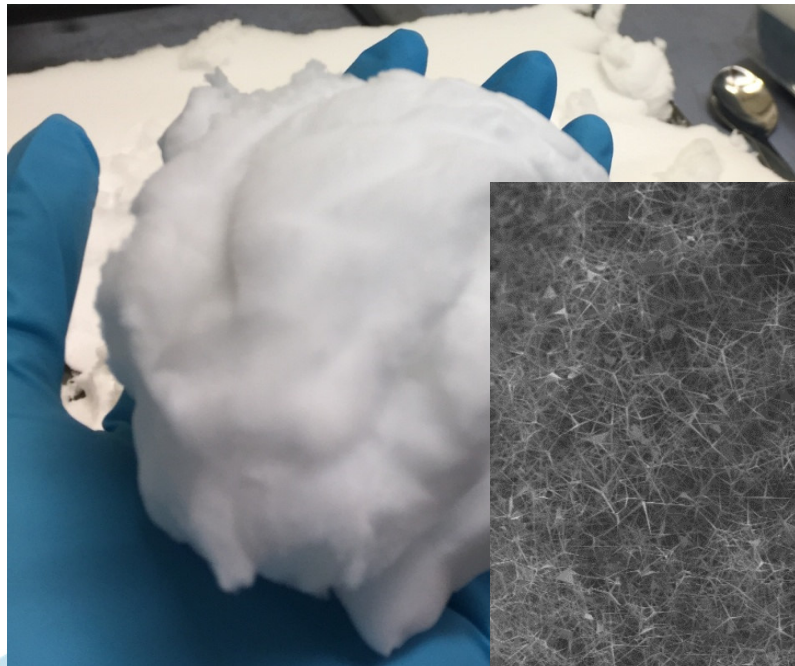
Product: t-ZnO



3. Optimisation and Production (production phase)

Product: t-ZnO

Brand:



4. Technology Transfer Documentation

For medical t-ZnO CSP production:

GMP (Good Manufacturing Practice) certification strictly necessary and prescribed by law



4. Technology Transfer Documentation

GMP Definition

- GMP ("Good Manufacturing Practice") is the term "good manufacturing practice for pharmaceuticals"
- GMP is a set of regulations, codes, and guidelines for the manufacture of drug substances and drug products, medical devices, in vivo and in vitro diagnostic products, and foods.
- GMP is that part of quality assurance which ensures that the products are consistently manufactured and controlled to the quality standards appropriate to their intended use

Introduction: Why GMP?

- Only 2 Examples from history:
- Year 1901:
Children died of tetanus after diphtheria vaccination: the serum was contaminated (starting material)
- Year 1982:
Consumers of Tylenol (acetaminophen) died from cyanide poisoning:
Decomposition during storage (stability studies)

So, to prevent all this, the GMP regulations are necessary to apply!

GMP production requirements

- **Safety** - Product is free of unwanted side effects when used appropriately by patient
- **Identity** - Product exactly matches the labeling and related documents
- **Strength** - Product has correct concentration, therapeutic activity of active ingredient
- **Purity** - Product is free from contamination
- **Quality** - Product meets all standards, expectations and performs as claimed.

General guidelines to meet the GMP requirements

- **Premises** (*must be located to minimize risks of cross- contamination*)
- **Personnel** (*competent and appropriately qualified personnel in sufficient numbers*)
- **Equipment** (*construction, cleaning and maintenance*)
- **Sanitation** (*premises shall be cleaned, free from accumulated waste, dust, debris*)
- **Starting material** (*inventory, stored under appropriate conditions, purchased from approved sources*)
- **Manufacturing operations** (*carried out under the supervision of technical staff, precautions against mix-up and cross-contamination, **SOPs** shall be maintained*)
- **Validation**
- **QC systems** (*concerned with: sampling, specifications, testing, release procedures*)
- **Documentation**

General guidelines to meet the GMP requirements

- **Premises** (*must be located to minimize risks of cross- contamination*) ✓ done
- **Personnel** (*competent and appropriately qualified personnel in sufficient numbers*) ✓ done
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- **Documentation** ✓ done



Technology transfer: ZnO CSP Particles Sythesis



ZnO Core-Spike-Particles - a Phi - Stone brand
GMP certified clean-room synthesis

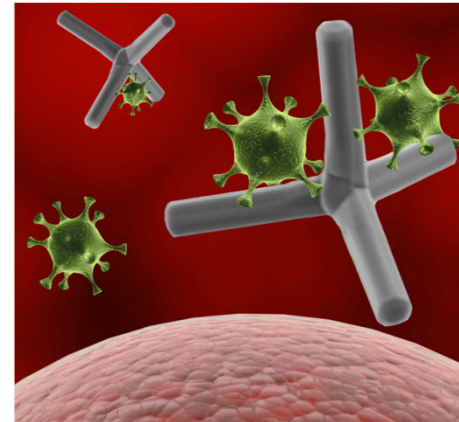
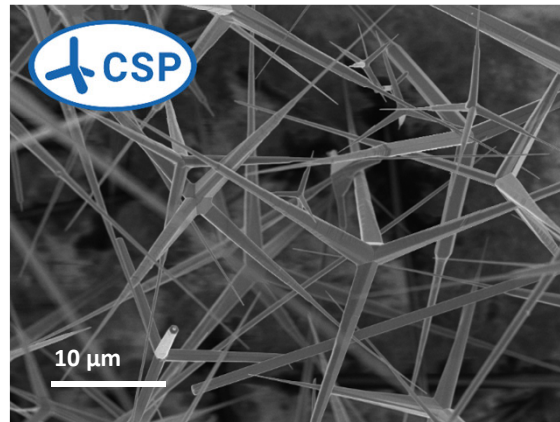


Technology antiviral zinc oxide

New product:

T-ZnO

- the „virus-trap“



Herpes-viruses „stick“ at the microcrystalline surface of Afinovir and get visible for the immune system. A direct and sustainable combat gets

Since 2019, Phi-Stone produces t-ZnO in accordance to GMP, available at pharmacy from June 2020



Christian-Albrechts-Universität zu Kiel

Technology antiviral zinc oxide

New product:

Afinovir
- the „virus-trap“



Afinovir® wound protection gel is used to cover for external protection against e.g. herpes viruses, as well as for faster healing of wounds, minor burns and sunburn.

Available at pharmacy from June 2022



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