

Zinc Oxide Tetrapods

Applicable for cosmetics and pharmaceutical products for new innovative and light high-performance textures

Product Name: Zinc Oxide Tetrapods

Chemical Symbol: t-ZnO

Production Process: Gas-phase synthesis according to GMP-standards

Chemical and physical properties:

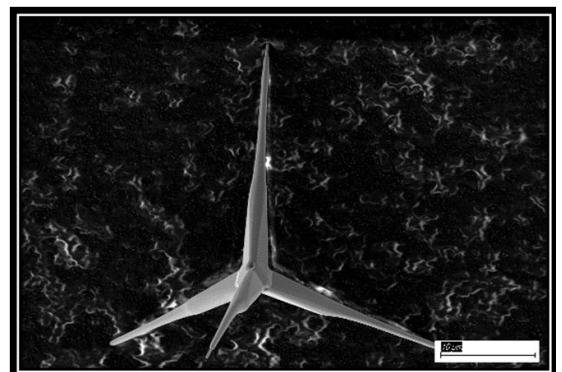
- t-ZnO according CAS 1314-13-2
- Analytics according to European Pharmacopoeia PH.Eur. 10.6ff
- Tetrapodal morphology with arm-length of 10µm to 200µm

Antimicrobial properties^{[1], [2]}

- Oxygen-deficiencies leading to an overall positively charged particle, able to electrostatically bind and immobilize viruses and bacteria
- Formation of reactive oxygen species, which impacts e.g. the virus shell
- Therapeutic window much bigger compared to standard ZnO due to much more controlled release of zinc ions to media.^[2]

Benefits

- Even small amounts of zinc oxide tetrapods (0.5%-2.0%) promotes cell proliferation, particularly in the skin, and contributes to accelerated wound healing.
- t-ZnO offers enhanced antimicrobial and wound-healing properties compared to conventional zinc oxide, making it a valuable asset in wound care, skin therapy, and infection prevention
- The different morphology leads to t-ZnO having greater surface area, enhanced mechanical properties, and superior performance



[1] Siebert et al., *Adv. Funct. Mater.* **2021**, *31*, 2007555.

[2] Mishra, Adelung, *Mat. Today* **2018**, *21*, 6, 631.

Benefits of Zinc Oxide Tetrapods Compared to spherical Zinc Oxide nano-Particles

Selective Cytotoxicity

Evidence was found that Zinc Oxide tetrapods show significantly lower cytotoxic effects compared to conventional spherical Zinc Oxide nano particles in following studies:

- **Selective Cytotoxicity:** „the threshold dose of zinc oxide nanoparticles was lethal to proliferating pluripotent mesenchymal stem cells but exhibited negligible cytotoxic effects to osteogenically differentiated mesenchymal stem cells“ ([10.2147/IJN.S16581](https://doi.org/10.2147/IJN.S16581))
- **Selective Cytotoxicity Based on Cell Tests Using Fibroblasts:** „the toxic potency of Zinc Oxide tetrapods is found to be significantly lower than that of spherical Zinc Oxide nanoparticles“ (<https://doi.org/10.1371/journal.pone.0084983>)
- **Studies on the antibacterial effect:** „Compared to the much smaller and less crystalline spherical Zinc Oxide particles, Zinc Oxide tetrapods show massively weaker toxicity in eukaryotic cell culture“ (<https://doi.org/10.3390/ijms24043444>)
- **Cell Tests:** „Our results showed that the branched Zinc Oxide particles did not induce any cytotoxic effects after incorporation within PCL mats. On the other hand, the scaffolds containing 5% (w/v) of spherical particles showed slight inhibitory effects on cellular growth“ (<https://doi.org/10.1021/acs.nanolett.7b02929>)
- **Tests on A375-Cell-Lines:** „The degree of cytotoxicity was measured as follows: tetrapods<nanorods<nanoparticles“ (<https://doi.org/10.1002/sml.200500193>)

Antiviral Efficacy

Zinc Oxide tetrapods show higher antiviral efficacy compared to Zinc Oxide nanoparticles.

- „Both ZnO(NP) and ZnO(TP) displayed potent antiviral activity against hepatitis E and hepatitis C viruses, with the latter being more effective. Measurement of cell viability and intracellular reactive oxygen species levels revealed that both ZnO(NP) and ZnO(TP) are noncytotoxic to the cells even at significantly higher doses, compared to a conventional zinc salt (ZnSO₄).“ (<https://doi.org/10.3389/fmicb.2022.881595>)

Influence of the Concentration of Zinc Oxide Tetrapods on the Wound Healing

- „This study shows that Zinc Oxide tetrapods inhibit wound-healing processes such as fibroblast proliferation, migration, trans-differentiation and cytokine release.“ (<https://doi.org/10.3390/life12111691>)
- **Usage of Zinc Oxide Tetrapods in Wound Patches:** „[...] hydrogel patches containing Zinc Oxide tetrapods show low cytotoxicity and improved angiogenic properties while maintaining antibacterial functions in vitro“ (<https://doi.org/10.1002/adfm.202007555>)