

Zulassung von TiO<sub>2</sub> überprüfen

# Toxisches Titandioxid bedroht Umwelt und Gesundheit

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Lebensmittel dürfen auch bei uns kein Titandioxid mehr enthalten, Medikamente hingegen schon. Dies, obwohl seine Toxizität aufgrund der physikalischen Eigenschaften bei der Zulassung unterschätzt wurde.

## Referenzen

**AMIANO I et al. (2012).** Acute Toxicity of Nanosized TiO<sub>2</sub> to Daphnia Magna under UVA Irradiation, SETAC 2012, Environmental Toxicology and Chemistry, Vol. 31, No. 11, S. 2564–2566. (zitiert im Artikel als AMIANO, Acute toxicity)

**BENNABOU A K et al. (2007).** Photocatalytic inactivation of Escherichia coli Effect of concentration of TiO<sub>2</sub> and microorganism, nature, and intensity of UV irradiation, Elsevier, Applied Catalysis B: Environmental 76 (2007) 257–263. (zit. BENNABOU, Inactivation)

**CARP O et al. (2004).** Photoinduced reactivity of titanium dioxide, in: Progress in Solid State Chemistry 32 (2004), S. 33–177. (zit. CARP, Titanium dioxide)

**CHO M et al. (2004).** Linear correlation between inactivation of E. coli and OH radical concentration in TiO<sub>2</sub> photocatalytic disinfection, Elsevier, Water Research 38 (2004) 1069–1077. (zit. CHO, Correlation)

**CROSSEN S L, GOSWAMI T (2022).** Nanoparticulate carriers for drug delivery, in: J Pharm Biopharm Res, 2022, 4(1): 237–247. (zit. CROSSEN, Carriers)

**DOMINGOS R F et al. (2009).** Aggregation of Titanium Dioxide Nanoparticles: Role of a Fulvic Acid, Environmental Science & Technologie, Vol. 43, No. 5, 2009, S. 1282–1286. (zit. DOMINGOS, Aggregation)

**FALBE J, REGITZ M (Hrsg. 1999).** Römpf-Lexikon Chemie, 9. Auflage u.d.T.: Römpf-Chemie-Lexikon Bd. 6 T-Z, 10., völlig überarbeitete Auflage. (zit. FALBE, Lexikon Chemie)

**FARKAS J et al. (2015).** Impact of TiO<sub>2</sub> nanoparticles on freshwater bacteria from three Swedish lakes, Sci Total Environ (2015). (zit. FARKAS, Impact)  
<http://dx.doi.org/10.1016/j.scitotenv.2015.03.043>, letztmals besucht am 06.06.2022.

**HALLIWELL B, GUTTERIDGE J M C (2015).** Free Radicals, in: Biology & Medicine, 5th Edition, Oxford. (zit. HALLIWELL, Radicals)

**HASHIMOTO K et al. (2005).** TiO<sub>2</sub> Photocatalysis: A Historical Overview and Future Prospects, in: Japanese Journal of Applied Physics, Vol. 44, No. 12 (2005) S. 8269 – 8285.  
(zit. HASHIMOTO, TiO<sub>2</sub>)

**HAYNES V et al. (2017).** Photocatalytic effects of titanium dioxide nanoparticles on aquatic organisms – Current knowledge and suggestions for future research, Elsevier, Aquatic Toxicology 185 (2017), S. 138–148. (zit. HAYNES, Effects)

**HENDRIX Y et al. (2015).** Titania-Silica Composites: A Review on the Photocalalytic Activity and Synthesis Methods, in: World Journal of Nano Science and Engineering, 2015, 5, S. 161–177.  
(zit. HENDRIX, Titania-Silica)

**HOLLEMAN A F et al. (2007).** Lehrbuch der Anorganischen Chemie, 102. Auflage, Walter de Gruyter & Co., Berlin. (zit. HOLLEMAN, Lehrbuch)

**HOUSECROFT C E, SHAPE A G (Hrsg. 2006).** Anorganische Chemie, 2. aktualisierte Auflage, München.  
(zit. HOUSECROFT, anorg. Chemie)

**HUND-RINKE K, SIMON M (2006).** Ecotoxic Effect of Photocatalytic Active Nanoparticles (TiO<sub>2</sub>) on Algae and Daphnids, ESPR – Environ Sc & Pollut Res 2006, S. 1–8. (zit. HUND-RINKE, Ecotoxic)

**JAEGER C D, BARD A J (1979).** Spin Trapping and Electron Spin Detection of Radical Intermediates in the Photodecomposition of Water and TiO<sub>2</sub> Particulate Systems, in: The Journal of Physical Chemistry, Vol. 83, No. 24, 1979. (zit. JAEGER, Spin Trapping)

**KIRSCH H (2011).** Visible light photocatalysis by metal halide coplexes containing titania as semiconductor ligand, in: Advances in Inorganic Chemistry, Volume 63 (2011), Inorganic Photochemistry, Elsevier Inc., London. (zit. KIRSCH, Visible light)

**KRUG HARALD F., WICK PETER:** Nanotoxicology: An Interdisciplinary Challenge, Wiley-VCH Verlag GmbH & Co KGaA, Weinheim, Angewandte Chemie, International Edition 2011, 50, S. 1260 – 1278.  
(zit. KRUG, Interdisciplinary)

**MANESS P et al. (1999).** Bacterial Activity of Photocatalytic TiO<sub>2</sub> Reaction: Towards an Understanding of its Killing Mechanism, in: Applied and Environmental Microbiology, Sept. 1999, S. 4094–4098.  
(zit. MANESS, Bacterial activity)

**MANSFIELD C M et al. (2015).** Photo-induced toxicity of titanium dioxide nanoparticles to *Daphnia magna* under natural sunlight, Elsevier, Chemosphere 120 (2015), S. 206–210.  
(zit. MANSFIELD, Toxicity normal sunlight)

**METZLER D M et al. (2011).** Responses of algae to photocatalytic nano-TiO<sub>2</sub> particles with an emphasis on the effect of particle size, Elsevier, Chemical Engineering Journal 170 (2011), S. 538–546.  
(zit. METZLER, Responses)

**NIOSH (2011).** The National Institute for Occupational Safety and Health (2011). Occupational Exposure to Titanium Dioxide, Current Intelligence Bulletin 63, 2011. (zit. NOSH, Exposure)

**MOSER J E (1986).** Dynamiques des réactions de transfert d'électrons induites par la lumière à la surface des semiconducteurs colloïdaux, Diss. ETH Lausanne, 1986. (zit. MOSER, Dynamique)

**OHTANI B (2011).** Photocatalysis by Inorganic Solid Material, in : Advances in Inorganic Chemistry, Volume 63, Inorganic Photochemistry, Elsevier Inc., London. (zit. OHTANI, Photocatalysis)

**PELAEZ M et al. (2012).** A review on the visible light aktive titanium dioxide photocatalysts for environmental applications, in: Applied Catalysis B: Environmental 125 (2012), S. 331–349.  
(zit. PELAEZ, Titanium dioxide)

**PFENNIG B W (2015).** Principles of inorganic chemistry. John Wiley & Sons, Inc., New Jersey.  
(zit. PFENNIG, Principles)

**REBHAN B et al. (2010).** Nanotechnologie in der Pharmazie und angrenzenden Gebieten – Grundlagen und Analytik, Nürnberg. (zit. REBHAN, Nanopharmazie)

**REEVES J F et al. (2008).** Hydroxyl radicals [OH•] are associated with titanium dioxide (TiO<sub>2</sub>) nanoparticle-induced cytotoxicity and oxidative DNA damage in fish cells, Elsevier, Mutation Research 640 (2008) 113–122. (zit. REEVES, Hydroxyl Radicals)

**RIEDEL E, JANIAK C (2015).** Anorganische Chemie, 9. Aufl., Walter de Gruyter GmbH, Berlin und Boston.  
(zit. RIEDEL, anorg. Chemie)

**RINCÓN ANGELA G, PULGARIN C (2003).** Photocatalytical inactivation of *E. coli*: effect of (continuous-intermittent) light intensity and of (suspended-fixed) TiO<sub>2</sub> concentration, in: Applied Elsevier, Catalysis B: Environment 44 (2003) 263–284. (zit. RINCON, Inactivation)

**RUIZ P A et al. (2017).** Titanium dioxide nanoparticles exacerbate DSS-induced colitis: role of the NLRP3 inflammasome, in: Gut 2017; 66:1216–1224. (zit. Ruiz, Colitis)

**SERPONE N et al. (2012).** On the genesis of heterogeneous photocatalysis: a brief historical perspective in the period 1910 to the mid - 1980s, in: Photochem. Photobiol. Sci., 2012, 11, 1121 ff. (zit. SERPONE, Photocatalysis)

**SERPONE N, DARREN L (1995).** Subnanosecond Relaxation Dynamics in TiO<sub>2</sub> Colloidal Sols (Particle Sizes Rp = 1.0 – 13.4 nm). Relevance to Heterogeneous Photocatalysis, in: J. Phys. Chem. 1995, 99; 16655 – 16661. (zit. SERPONE, Dynamics)

**SHI H et al. (2013):** Titanium dioxide nanoparticles: a review of current toxicological data, Particle and Fibre Toxicology 2013, 10:15. (zit. SHI, Review)

**STEINLE J (1974).** Chemische und photochemische Reaktionen an der Titandioxidoberfläche, Diss. München. (zit. STEINLE, Reaktionen)

**VEVERS W F, JHA A N (2008).** Springer, Ecotoxicology (2008) 17:410–420.  
(zit. VEVERS, Genotoxic and cytotoxic)

**VINU R., MADRAS G (2010).** Environmental remediation by photocatalysis, in: Journal of the Indian Institute of Science, Vol. 90:2, Apr – Jun 2010, journal.library.iisc.ernet.in, S. 189 – 320.  
(zit. VINU, Environmental)

**XIAOLI Y et al. (2022).** Titanium nanosheet as robust and biosafe drug carrier for combined photochemo cancer therapy, in: Journal of Nanobiotechnology (2022) 20:154. (zit. XIAOLI: Titanium Nanosheet)

## Abbildung, S. 13 im Artikel

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