Stabilization of TiO₂ Nanoparticles in Cell Culture Media

S. Koch¹, S. Hackenberg³, S. Dembski¹, K. Heuzé²
¹ Fraunhofer Institute for Silicate Research ISC, Neuenplatz 2, 79082 Würzburg, Germany
² University of Bordeaux, UMR-5225, 351 cours de la Libération, 33405 Talence, France
³ Department of Oto-Rhino-Laryngology, Plastic, Aesthetic and Reconstructive Head and Neck Surgery, University Clinic Würzburg, Josef-Schneider-Str. 11, 79080 Würzburg, Germany

Titanium dioxide nanoparticles are of great interest for tumor therapy due to their photocatalytic activity. Stable TiO₂ nanoparticle dispersions are a crucial requirement for reliable cell culture experiments concerning toxicity studies or tumor therapy experiments [1, 2]. As most nanoparticles do not show colloidal stability in cell culture media due to its pH and salt content, suitable surfactants have to be found. The effectively of a surfactant depends on the nanoparticle type, its surface properties and the chosen cell culture media. Therefore, there is no simple solution for stabilizing nanoparticles and it has to be found the most adequate surfactant in every single case [1, 3, 4]. Consequently, this study intended to stabilize self-synthesized TiO₂ nanoparticles in three different cell culture media (Dulbecco’s Modified Eagle Medium (DMEM), Roswell Park Memorial Institute Medium (RPMI) and Bronchial Epithelial Cell Growth Medium (BEGM)). For the stabilization, various commercial products were utilized that had already been cell culture tested, like BSA (bovine serum albumine), FBS (foetal bovine serum) or tween80. Furthermore some surfactants were examined that had not yet been used for this purpose, e.g. PCE (Polyoxyethylene ether) or Brij30. The most promising stabilizers for FBS and PCE for RPMI are presented here.

**TiO₂ Nanoparticles**
- Hydrothermal synthesis
- Controllable, monodisperse particle and crystallite size: 8 nm
- Anatase phase
- Organic surface moieties
- acetylacetone
titanium ethoxide
water
para-toluolsulfonic acid
- hydrolysis & condensation
- precursor sol
- gel formation
- nanoparticle growth
- nanoparticle sol

**Agglomerate Size**
- Dynamic light scattering measurement of nanoparticle with different FBS or PCE concentrations in RPMI
- Stabilized following the developed protocol

**Cytotoxicity of stabilized NPs**
- MTT assay
  - (3-4,5-dimethylthiazolyl-2-yl)-2,5-diphenyltetrazolium bromide
- FaDu human epithelial cell line
  - (from a squamous cell carcinoma of the hypopharynx)
  - in RPMI, 24 h incubation, 37 °C, 5 % CO₂
- Particles not stabilized, PCE stabilized (NP : FBS = 1 mg : 400 µg), FBS stabilized (NP : FBS = 1 mg : 100 µg)

**Summary**
- Stabilization of NP in cell culture media with the help of FBS or PCE.
- No sedimentation over 24 h
- Agglomerate size smaller than 200 nm in diameter
- No negative effects of stabilizers on cell toxicity of the NP

**Outlook**
- Examination of NP uptake by cells via TEM
- In vitro test for tumor treatment via photocatalytic activation of the TiO₂ NP

**Stabilization Protocol**
- Dynamic light scattering measurement before and after ultrasonic (US) treatment

**Sedimentation**
- Absorption measurement at 490 nm, 24 h (every 20 min), at room temperature
- 0.5 mg/ml particles in RPMI
  - Particles not stabilized, PCE stabilized (NP : FBS = 1 mg : 400 µg), FBS stabilized (NP : FBS = 1 mg : 100 µg)

**Cytotoxicity of PCE**
- MTT assay
- FaDu human epithelial cell line
  - in RPMI, 24 h incubation, 37 °C, 5 % CO₂

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**Literature**

Fraunhofer Institute for Silicate Research ISC
Neuenplatz 2, 79082 Würzburg
www.isc.fraunhofer.de

Persons to contact: Susanne Koch
susanne.koch@isc.fraunhofer.de
Soﬁa.Dembski@isc.fraunhofer.de