



Cytotoxicity of Titanium Dioxide Nanoparticles

Stefanie Wagner, Cornelia Kasper, Thomas Scheper, Detlef Bahnemann

Institut für Technische Chemie der Leibniz Universität Hannover, Callinstr. 3, D-30167 Hannover

Introduction

The toxicity of TiO₂ nanoparticles on different mammalian cell lines were investigated. The particles differ in their size, their BET-surface-area and their crystal structure. There was also a classification in fixed particles and in particles easily accessible in solution.

Nanoparticles can be incorporated into the human organism via the skin, via respiratory tract and via alimentary system. Therefore the particles were tested with fibroblasts (NIH-3T3), with lung cells (A-549), with liver cells (HEP-G2) and with kidney cells (PC-12). By photometric measurements the transformation of a dye formed by living cells was determined (MTT-test).

Materials and Methods

Cell culture

All cells were cultivated in an adequate culture medium in an incubator (37°C / 5 % CO₂).

Cultivation on TiO₂ coatings

Powders were suspended in the culture medium. Wells were coated with suspensions containing 0.1 % powders in the medium. The plates were seeded with a defined number of cells.

Cultivation in TiO₂ suspensions

Plates were seeded with a defined number of cells. The suspensions were added to the cells in a concentration of 0.1 % in the culture medium.

Cell metabolism

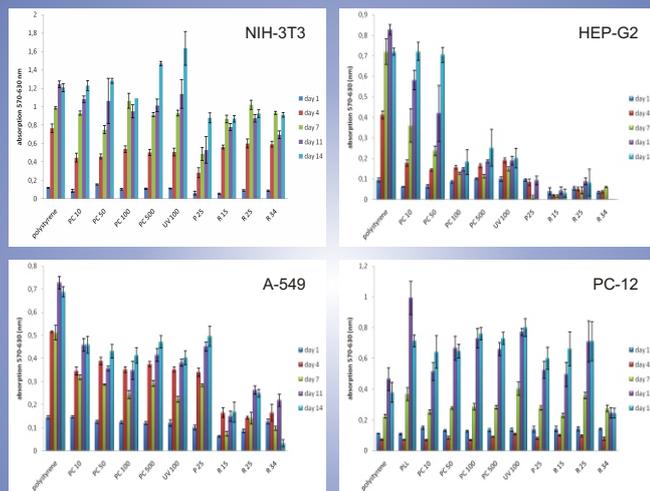
The viability of the cells was determined by MTT-test.

Tested Particles

Powders	crystal structure	size of the nanoparticles (nm)	BET-surface area (m ² /g)
PC 10	100 % anatase	152	10
PC 50	100 % anatase	40	50
PC 100	100 % anatase	26	90
PC 500	100 % anatase	7	340
UV 100	100 % anatase	5-13	290
P 25	80 % anatase 20 % rutile	37 (anatase) 90 (rutile)	50
R 15	100 % rutile	20	65
R 25	100 % rutile	27	42
R 34	100 % rutile	36	33

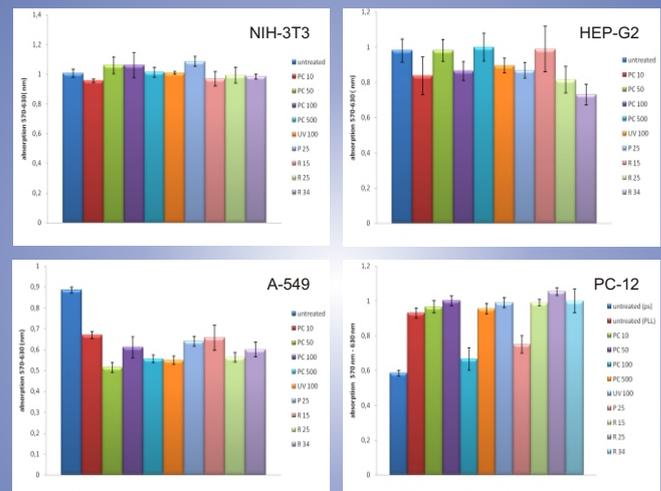
Results

Cultivation on TiO₂ coatings



The figures show the viability of the cells cultivated on the different powder coatings over a period of 14 days. Applied is the average of adsorption on 5 different measuring times and the standard error.

Cultivation in TiO₂ suspensions



The figures show the viability of the cells cultivated in presence of TiO₂ suspensions in the culture medium. Applied is the average of adsorption and the standard error.

Conclusions

The adhesion of the cells on the different powders highly depends on the type of cell lines and the type of powder. It was show that the lower viability of some cells on the powders are not only caused by a cytotoxic effect of the powders, but are also due to a lower adhesion of the cells on the surfaces. Furthermore, it was show that the physical properties of the powders do not refer to any observed biological effect. The tested TiO₂ nanoparticles have no toxic effect on the cells.