

Abstract from the AMAS group meeting 10th of August, 2010.

IPU, Inst. for Product Development.

The questions of the IPU group to be answered are:

- How does the mode of contamination affect performance?
(direct contact, aerosoles, dry particles, electrostatically charged particles)
- What are the surface properties?
- How to decontaminate the surface?

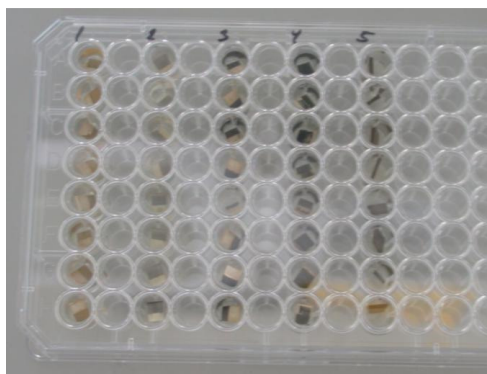
Initiated: Testing and validation of TiO₂ and Cu + TiO₂ coated steel plates.

Keywords for the research:

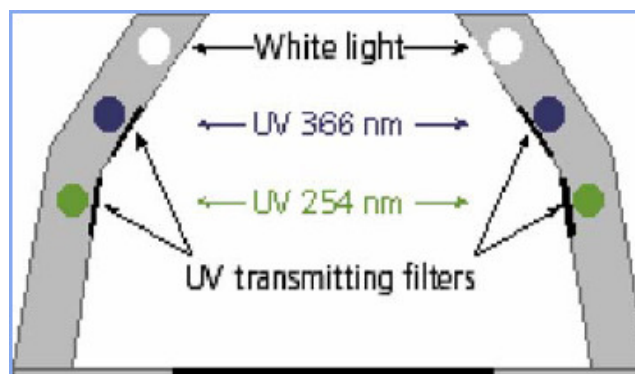
- Correlation between surface modification, surface structure, clean-ability and adherence of microorganisms.
- Tests facilities for analysis of a wide range of microorganisms on non transparent surfaces

A literature study and preparation of a paper: "Performance testing of hygienic surfaces - a review" is on its way.

Test procedure:



Test items are suspended in a substrate containing 10³ colony forming units (cfu) of *Escherichia coli*



Cross section of UV irradiation setup (Camac-TLC Visualizer). Microtiter plate with test items are placed on the bottom plate and irradiated, e.g. 10 min. at 366 nm

In this test TiO₂ coated stainless steel plates, Cu+TiO₂ coated stainless steel plates and untreated stainless steel plates were tested. The test items were placed in microtiter plates and a growth substrate containing approx. 1000 viable *Escherichia Coli* bacteria per ml were added. The plates were irradiated with UV light for 10 or 20 min. Packed in polyethylene bags. Incubated for 24 hours at 37°C with agitation (200 rpm) to ensure optimal growth conditions. Every day the test items were moved to a new microtiter plate, fresh growth medium with bacteria was added, the plates irradiated, packed and reincubated as before. Optical density (an absorbance measure) was measured on the used growth substrate in order to get an estimation of survival and growth.

After 14 and 21 days test items were rinsed to remove bacteria that was not attached to the surface. The bacterial biofilm was subsequently released from the surface by sonication in an ultrasound water bath, and the number of bacteria was determined by plating on growth substrate.

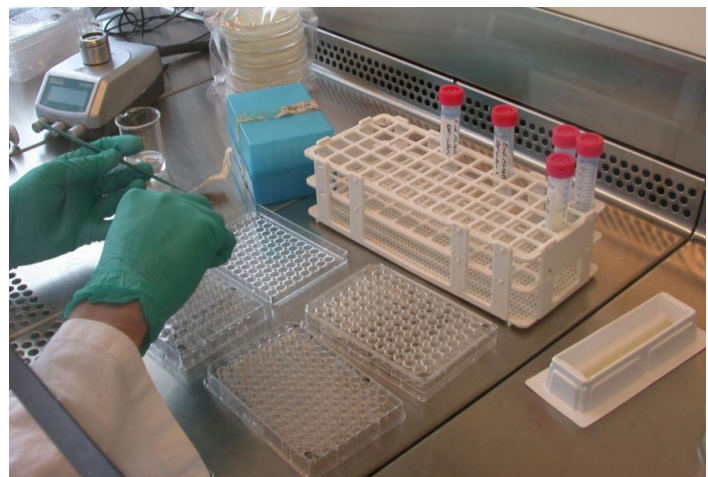
Radiation for 10 min., 366 nm, showed no reductive effect in bacterial density. A longer irradiation with 366 nm still didn't show effect. By 20 min., 254 nm, after a 3 week cyclus, the test finally came up with a positive result. The tests were performed on TiO₂ coated stainless steel plates and Cu+TiO₂ coated steel plates. The latter showed no significant effect. According to literature a Cu doping of TiO₂ should reduce the bandgap of the semiconductor thus enabling the oxidation of organic material for a larger spectrum of light. Even with no light a Cu doped TiO₂ coating should to some extent be active.

Conclusion:

The test so far confirms, that a TiO₂ coating is photocatalytic active by reducing bacterial colonies of *E. coli* on the surface of the test item. The test cyclus was not optimized for optimal effect of TiO₂. The test procedure and UV irradiation setup will be optimized in the next experiments. Dependence on UV intensity still needs to be investigated.



Incubation for 24 hours at 37 °C with agitation (200 rpm)



Transfer to new plates and reinoculation

OD (Optical Density) is measured on 24 culture



Degree of contamination on the surface of two test items after 21 days

