

Self-cleaning cotton textiles surfaces modified by photoactive SiO₂/TiO₂ coating

T. Yuranova^a, R. Mosteo^a, J. Bandara^{a,c}, D. Laub^b, J. Kiwi^{a,*}

^a *Laboratory of Photonics and Interfaces, Institute of Chemical Sciences and Engineering, 1015 Lausanne, Switzerland*

^b *Interdisciplinary Center for Electron Microscopy (CIME) of the Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland*

^c *Institute of Fundamental Studies, Hantana Road, CP 20 000, Kandy, Sri Lanka*

Received 24 June 2005; received in revised form 31 August 2005; accepted 31 August 2005

Available online 10 October 2005

Abstract

The photocatalytic activity of TiO₂-SiO₂-coated cotton textiles was investigated through the self-cleaning of red wine stains. It was shown that a TiO₂-SiO₂ species could be produced at temperatures of 100 °C with acceptable photo-activity on non-heat resistant materials. The most suitable Ti-content of the coating was found to be 5.8% and for SiO₂, the content was 3.9% (w/w). The discoloration of red wine led to CO₂ evolution that was more efficient for TiO₂-SiO₂-coated cotton for samples than of TiO₂-coated ones. The reasons for these results are discussed. The textile surface did not show any change after several consecutive light-induced discoloration cycles of a red wine stain. By high-resolution transmission electron microscopy (HRTEM), the TiO₂-SiO₂ layer thickness on the cotton fibers was detected to 20–30 nm. The TiO₂ and SiO₂ were both observed to have particle sizes between 4 and 8 nm. Further electron microscopy work coupled with energy dispersive spectroscopy (EDS) showed that the Ti-particles were always surrounded by amorphous SiO₂ and never alone by themselves. Infrared spectroscopy revealed that no modification of the cotton could be detected after photo-discoloration processes with TiO₂-SiO₂, taking a wine stain as model compound. The mixed TiO₂ and SiO₂ colloids lead during the dip-coating and subsequent thermal treatment on cotton to an organized structure of highly dispersed TiO₂ particles always surrounded by amorphous silica.

© 2005 Elsevier B.V. All rights reserved.

Keywords: Self-cleaning; Cotton textiles; Wine stains; TiO₂-SiO₂ coating; Photocatalysis
