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Insight into the catalyst/photocatalyst microstructure presenting the same composition but leading to a variance in bacterial reduction under indoor visible light

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ABSTRACT: Insight into two different uniform atomic-scale microstructures of Cu- and Ti-oxides sputtered on polyethylene (PET) presenting different *redox* properties and a distinct bacterial inactivation dynamics. Co-sputtered (CuOx-TiO_2-PET) consists mainly of CuO. It leads to bacterial inactivation kinetics within 20 min under very low intensity actinic light (0.5 mW/cm^2). The sequential sputtered (CuOx/TiO_2-PET) consist mainly of Cu_2O and led to bacterial inactivation within 90 min. Evidence for redox catalysis is present leading to bacterial inactivation by X-ray photoelectron spectroscopy (XPS). The Cu and Ti uniform distribution on the catalyst surface was mapped along the coating thickness by wavelength dispersive spectrometry (WDS). The inactivation time of *E. coli* determined by fluorescence stereomicroscopy was in agreement with the time found by agar plating. The short-lived transient intermediates on the co-sputtered catalyst were followed by laser spectroscopy in the femto/picosecond region (fs-ps). By atomic force microscopy (AFM) the roughness of the co-sputtered (CuO) and sequentially sputtered samples (Cu_2O) were found respectively as 1.63 nm and 22.92 nm. The magnitude of the roughness was correlated with the bacterial inactivation times for both types of catalysts. The differentiated mechanisms for the vectorial charge transfer on co-sputtered and sequential sputtered CuOx/TiO_2catalysts and it is suggested as one of the factors leading to a distinct bacterial inactivation kinetics

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