Light induced pH-changes in responsive hydrogel composites

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Photoexcitation of titania is known to lead to a charge separation, which in contact with water may lead to water splitting. If a titania film is coated with a hydrogel film, this may lead to a pH change, and if this film is pH sensitive, this may lead to swelling of the film. This is demonstrated in this contribution, studying a pH sensitive polyelectrolyte multilayer film of a positively charged weak polyelectrolyte and a weak or strong anionic polyelectrolyte on a titania support (Fig.1).The latter can also be sensitized to visible light by ultrasonic treatment. Following light irradiation the film can swell, reducing the Young's modulus by almost 2 orders of magnitude, as measured by colloidal probe AFM. Preosteoblasts, preferring a hard template consequently move from the swollen part of the film to the harder part. With local pH probes we show that the pH can be reduced to about 4, and this remains over many 10 minutes. Estimates of light intensities and charge carrier concentrations also reveal, that this effect is not confined to TiO₂, but to many semiconductors, including nanoparticles in contact with a responsive polymer environment. In the latter case one may disperse the nanoparticles in a matrix that can be swollen by light and thus, e.g. mechanical scratches can be annealed.



Fig.1: Top: Micrographs of preosteoblasts on a hydrogel film on a glass (zones 1-4) and a titania support (zones 5-8) before (left) and after illumination (right). Bottom left: cell density after light treatment. Bottom right: Sketch of the experiment.

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