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Smart nanostructured systems for controlled delivery of molecular payloads

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We report on the layer-by-layer (LBL) supramolecular assembly of redox responsive, organometallic poly(ferrocenylsilanes) (PFS) films on planar and porous substrates. Positively or negatively charged side groups render PFS water soluble and these polyelectrolytes allow the use of electrostatic self-assembly process for the fabrication of novel functional supramolecular nanostructures. PFS polyanions and polycations were first used to assemble multilayers on planar ITO electrode. UV/Vis spectroscopy and ellipsometry showed a linear increase of UV absorbance, and film thickness. Electrochemical behaviour of the redox multilayers with different thickness was recorded by capturing cyclic voltammograms (CVs). Film disassembly (multilayer re-dispersed in water) was performed by exposing the multilayers to the different values of holding potentials, corresponding to partial or full oxidation of PFS. Disassembly kinetics was quantitatively monitored by determining the amount of polymer released from CV experiments, as well as from UV/Vis spectroscopy. The release of encapsulated guest molecules such as labelled Dextran, Alexa Fluor®488 at different depths in the multilayer films was studied by fluorescence spectroscopy. For the preparation of multilayer films on Al_2O_3 membrane template, relatively high concentration of PFS solution was employed. PFS nanotubes were subsequently obtained by template removal using sodium hydroxide. The wall structure and characteristics of PFS nanotube received particular attention. The tubular structures were verified by the confocal laser scanning microscope (CLSM) using labeled Dextran, Alexa Fluor®488 as probe, as well as the measurements of SEM and TEM. These assembled nanotubes are excellent candidates for the investigation of guest payload release control triggered by redox stimuli.

Biography

Song Jing has completed her Ph.D in 2007 from University of Twente, The Netherlands, under supervision of Prof. G. J. Vancso. Now she is working in Institute of Materials Research and Engineering, an ASTAR research institute in Singapore, as a research Scientist. She has published more than 20 papers in reputed journals and presented in over 20 conferences, talks, and seminars. Her current research interest is stimulus responsive polymers for biomedical applications.

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Impact studies and optimization of hemisphere hybrid composite laminates

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The paper examines the experimental impact response of symmetrical and unsymmetrical hybrid composite laminates. Impact damage has an adverse effect on structural integrity, and potentially can lead to catastrophic failure. Examples are aircraft engine shells. Special attention is given to typical stacking sequences were used in various applications. Experimentally, load histories of the specimens are obtained, and a scheme for detecting the emergence of delamination is evaluated. Delamination was always accompanied by matrix cracking. Thickness and stacking sequence significantly affected the impact response. The loading and un-loading force – distance plot of the symmetrical plates are closer and similar, indicative of less energy absorption compared to unsymmetrical plates. In both cases, near the peak, a sudden load drop occurs followed by high frequency oscillations.

The design of hybrid composite structures is shown to be complicated by the number of design variables and the interaction of the constituents in the composite system. Since it is desirable to experimental test on the design, and it is not practical to test a full scale model, a structural/material similitude concept is used to create a small scale model with a similar structural response.

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