Keywords: Flexible, Interpenetrated, pcu

MS38 Nanomaterials & graphene

Chairs: Adrià Gil-Mestres, Michael Woerle

MS38-P1 Synthesis of $Ag@SiO_2$ nanorattles for controlled Ag^+ release

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Medical progress and an ageing world population have led to an increasing use of foreign materials inside the human body. Consequently also the number of infections related to these implants has grown significantly.[1] Antimicrobial coatings that prevent the formation of infectious biofilms on the surface of the implants could make an important contribution to overcome that issue. Silver is known for its good antimicrobial and biocompatible properties and could thus play an important role in the fight against implant infections, especially if they are caused by antibiotic resistant bacteria.[2]

This project investigates $Ag@SiO_2$ nanorattles as antimicrobial agent for implant coatings. These nanoparticles are characterized by a void between a silica shell and a Ag nanoparticle as cargo. [3] The silica shell protects the Ag cores from aggregation and prolongs the release of the antimicrobial active Ag^+ ions. Moreover it provides reactive sites to functionalize the nanocontainers in order to attach them covalently to implant surfaces or to incorporate them into polymer materials.

We have developed two different synthetic routes to $Ag@SiO_2$ nanorattles of different sizes. The microemulsion method[4] gives access to nanorattles with a diameter of ca. 25 nm (Fig. 1, top) that were evaluated for their Ag^+ release properties, antimicrobial potential and for their impact on cells of the immune system.[5]

The second synthetic approach is based on the coating of Ag nanoparticles with silica under classical Stöber conditions followed by a surface protected etching protocol[6]. This results in $Ag@SiO_2$ nanorattles with a diameter of ca. 80 nm (Fig. 1, bottom). Cytotoxicity tests showed a good biocompatibility. Their antimicrobial efficiency is currently under investigation.

Silver-containing silica nanorattles thus fulfill several requirements for the development of novel antibacterial nanocoatings on biomaterial surfaces.

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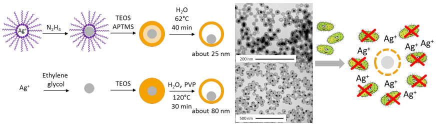

Figure 1. Synthesis and antimicrobial Ag^+ release of Ag@SiO_2 nanorattles: microemulsion method (top) and Stöber conditions followed by surface protected etching (bottom).

Keywords: nanocontainers, nanorattles, antimicrobial surfaces, silica, silver

MS38-P2 Dual-Responsive Lipid Nanotubes: Two-Way Morphology Control by pH and Redox Effects

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Lipid nanotubes are the preferred structures for many applications, especially biological ones. Here, we presented a two-way reversible morphology control of the nanotubes formed by the novel molecule AQUA ($C_{25}H_{29}NO_4$). The diameters of the AQUA nanotubes are 110±20 nm, and their lengths are 4-8 μm. AQUA has both pH-sensitive and redox-active characters provided by the carboxylic acid and anthraquinone groups. Upon chemical reduction, the nanotubes turned into thinner ribbons and this structural transformation was significantly reversible. Nanotube morphology can additionally be altered by decreasing the pH below the pKa value of the AQUA. The molecular length of AQUA is calculated as ~2 nm, and when this value is combined with the information gained from the XRD and cryo-TEM analysis such that the nanotubes have a multi-layered structure. The number of layers is either 2 or 3 and the total wall thickness is 4-6 nm at pH 9, this proves the claims that the d-spacing value of ~2 nm in the XRD spectrum gives the thickness of one layer in the tube walls and the wall structure is composed of symmetrical monolayers with a little space between them at pH 9. Decreasing the pH caused the gradual unfolding of the nanotubes and the inter-layer distance in the nanotube's walls increased. This morphological change is fast and reversible at a wide pH range (Fig.1).

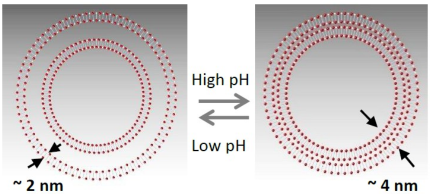

Figure 1. Schematic representation of the effect of pH on the membrane structure

Keywords: Lipid nanotube, Stimuli response, Redox-active, pH-sensitive, Conductive, XRD, TEM