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Hybrid mesoporous silica nanoparticles templated with surfactant polyion complex (SPIC) micelles for pH-triggered drug release

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New Surfactant PolyIon Complex (SPIC) micelles were formed by combining an antibacterial cationic surfactant, cetylpyridinium chloride (CPC), with a double hydrophilic block copolymer containing a neutral comb block called poly(oligo(ethylene glycol) methyl ether acrylate (PEOGA) and a weak polyacid block, known as (poly(acrylic acid) (PAA), through electrostatic complexation. These resulting SPIC micelles, with a CPC/PAA core and a PEOGA corona, were successfully utilized as both structure directing and functionalising agents in an environmental friendly sol-gel procedure for yielding hybrid mesoporous silica (MS) nanoparticles with diameters less than 100 nm and a monomodal pore size distribution centred at 2.8 nm. The influence of synthesis parameters, including the pH, concentrations and ratios of components, was systematically investigated. The obtained MS nanoparticles were intrinsically functional, with copolymers grafted to the pore surface *via* H-bonding between silica and the PEOGA blocks, while weak polyacid blocks, complexed with CPC, were confined within the mesopores. The response of these hybrid MS nanoparticles to fluctuations in pH (pH 7.4, 4.2 and 3) demonstrated exceptional stability of the anchored copolymer, while CPC was selectively released under acidic conditions typical of orodental biofilm microenvironments. This result is noteworthy, since the release of encapsulated amphiphilic drugs into water is less favourable than that of hydrophilic drugs. Owing to their dimensional, porous and chemical control, MS hybrid nanoparticles templated and functionalised with SPIC micelles will be materials of choice for developing pH-responsive biomedical devices using wet processing techniques.