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Electronic Supplementary Information

Synthesis, characterization, antibacterial activity and cytotoxicity of hollow TiO_2-coated CeO_2 nanocontainers encapsulating silver nanoparticles for controlled silver release

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Effects of sonication and ammonia-containing surfactant on AgNP/CeO_2/TiO_2 nanocontainers

In order to test the effects of sonication and surfactant on the nanocontainer integrity, three samples were prepared in the same way as usual, except that one sample did not contain any surfactant, one contained the non-ionic surfactant solution and the other contained the ammonia-containing surfactant solution. None of them contained titanium butoxide. Figure S1 shows the morphology of the nanocontainers after these treatments. The same nanocontainer disintegration and coalescence effects were observed in each sample, regardless of the surfactant. This demonstrates that sonication is responsible for the change of shape and the disintegration of the CeO_2 nanocontainers. However, the fact that this effect is considerably more common in these tests without titanium butoxide than during the TiO_2 coating synthesis suggests that TiO_2 coatings can protect the nanocontainers against disintegration.

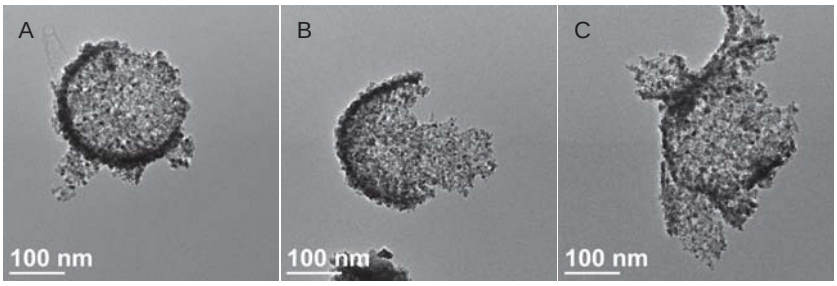

Figure S1: TEM images of CeO_2 nanocontainers after being sonicated for one hour in ethanol in the absence of any surfactant (A), in the presence of non-ionic surfactant (B) and in the presence of ammonia-containing non-ionic surfactant (C).

In order to test the effect of ammonia-containing surfactant solution, a surfactant solution without ammonia was prepared and used for coating CeO_2 nanocontainers with TiO_2. Since the ammonia would increase the electrostatic repulsion between particles, this would be expected to yield thinner coatings. In the absence of ammonia, the coating should therefore be thicker. This effect was in fact observed during TEM characterization (Figure S2). The

TiO_2 coating was so thick that the structure of the CeO_2 shell could hardly be observed. In some particles, electron-dense nanoparticles, probably corresponding to the AgNPs, are observed within or on the surface of the TiO_2 coating. This confirms that the ammonia is essential to ensure a thinner TiO_2 coating.

Figure S2: TEM images of AgNP/CeO_2/TiO_2 nanocontainers prepared with non-ionic surfactant solution without ammonia before calcination.

EDS spectrum of AgNP/CeO_2/TiO_2 nanocontainers

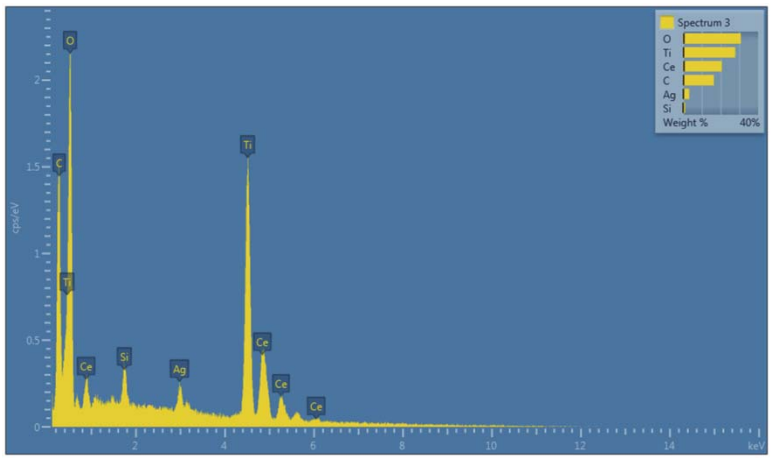

Figure S3: EDS of AgNP/CeO_2/TiO_2 nanocontainers before calcination. The carbon content originates from the carbon tape.