Supplementary Information

Tailored Silica Nanoparticles Surface to Increase Drug Load and Enhance Bactericidal Response

Luciane F. de Oliveira,[a] Karim Bouchmella,[a,b] Agustin S. Picco,[a,b] Larissa B. Capeletti,[a,c] Kaliandra A. Gonçalves,[d] João Henrique Z. dos Santos,[c] Jörg Kobarg[e] and Mateus B. Cardoso*[a,b]

[a]Laboratório Nacional de Luz Síncrotron, LNLS and [b]Laboratório Nacional Nanotecnologia, LNNano, CNPEM, CP 6192, 13083-970 Campinas-SP, Brazil

[c]Universidade Federal do Rio Grande do Sul, 91501-970 Porto Alegre-RS, Brazil

[d]Laboratório Nacional de Biociências, LNBio, CP 6192, 13083-970 Campinas-SP, Brazil

[e]Faculdade de Ciências Farmacêuticas e Departamento de Bioquímica e Biologia Tecidual, Instituto de Biologia, Universidade Estadual de Campinas, UNICAMP, CP 6154, 13083-970 Campinas-SP, Brazil

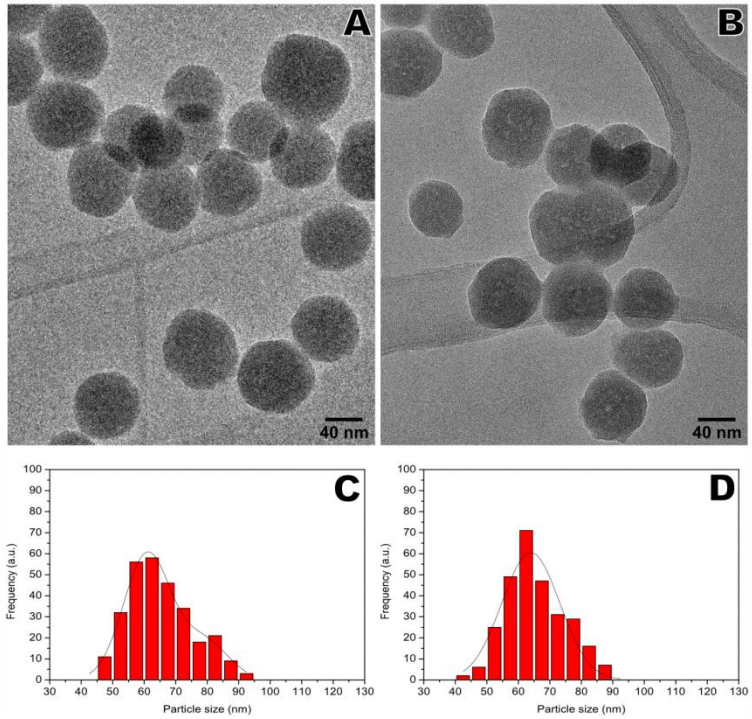

Figure S1. TEM images of (A) SiO_2-NH_2-200 and (B) SiO_2-NH_2-400 nanoparticles. Size distribution histograms of (C) SiO_2-NH_2-200 and (D) SiO_2-NH_2-400.

*e-mail: cardosomb@lnls.br, cardosomb@lnnano.cnpem.br

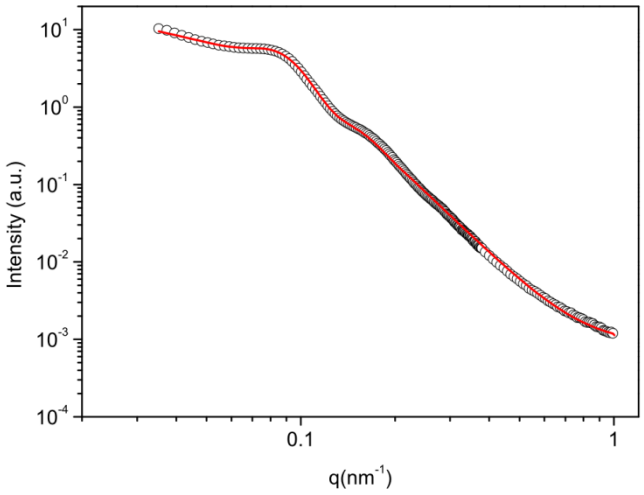

Figure S2. SAXS profile (open balls) of SiO_2-NH_2-400 and its best corresponding fit (solid red line).

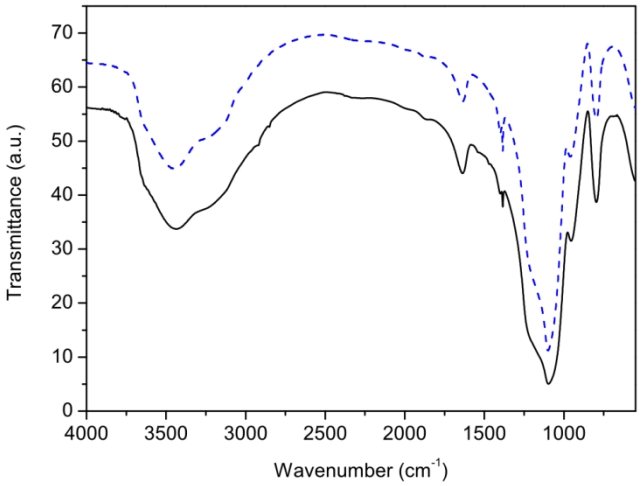

Figure S3. FTIR spectra of bare silica (dashed blue line) and SiO_2-NH_2-400 (solid black line).

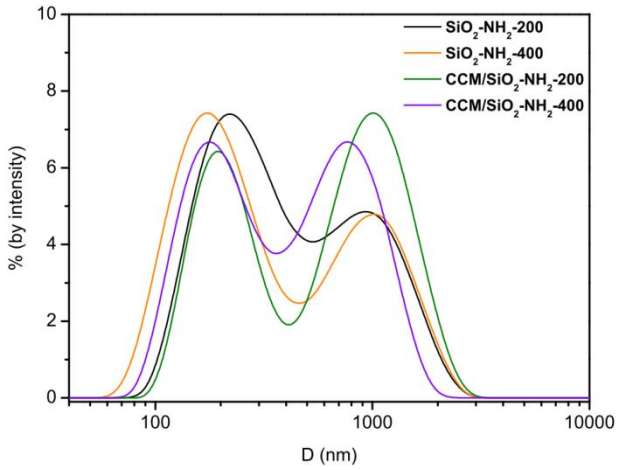

Figure S4. DLS-based size distributions. The nanoparticles were incubated in LB medium (at a concentration of 1 g L^{-1}) for 1 hour under sonication. The measures were performed over the obtained suspensions (without filtration) using a Malvern ZetaSizer ZS equipment, in triplicate (each measurement consisting in ten runs of 20 seconds each).

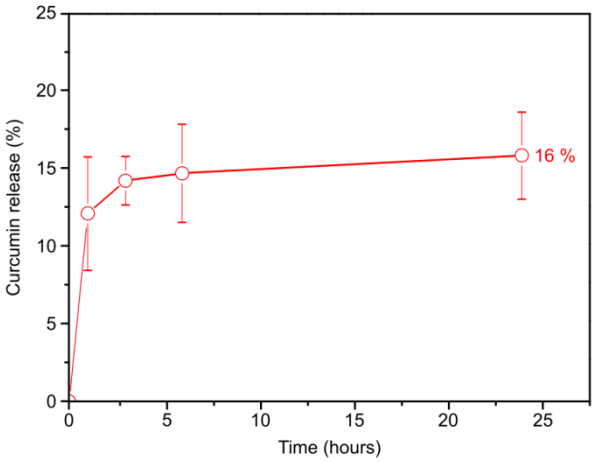

Figure S5. CCM release experiments for CCM/SiO_2-NH_2-400. Amino-functionalized nanoparticles loaded with curcumin (15 mg) were placed in a flask containing 1 mL of a PBS (10 mM, pH 7.4) medium at 37 °C under magnetic stirring. At predetermined intervals of time, 100 µL were collected from the suspension. After that, the supernatant was collected after centrifugation (14 000 rpm, 10 min) and analyzed by UV-Vis, while the solid residue was redisperdsed by ultrasound with 100 µL of the PBS medium and then added back to the original nanoparticles suspension. The released concentration as a function of time was analyzed by UV-Vis spectroscopy using an Agilent 8453 spectrophotometer at a wavelength of 347 nm. The total drug release is very close to the curcumin solubility in water.

Sample composition for biological experiments

TGA measurements were not able to precisely quantify the amount of amino groups and curcumin (CCM) associated to the particles due to the imprecision of the method as well as to the size of the error bars. Based on that, we have used the stoichiometric approach to learn about the samples' composition. Although, it is an estimate based on the full polymerization of TEOS and APTES, we are confident that these values are close to the real ones based on gravimetric measurements previously done in our laboratory as well as the data reported in the literature.[1]

We know that 60 µL of a 5% (m/v) CCM solution was used on the nanoparticle production. It makes 3 mg of CCM for each preparation. In the same reaction flask, we used 380 µL of TEOS (purity = 98%; density = 0.933 g mL^{-1} and Mw = 347.44 g mol^{-1}) that generates 101.40 mg of SiO_2 (Mw = 60.8 g mol^{-1}). In addition, APTES (purity = 99%; density = 0.946 g mL^{-1} and Mw = 321.3 g mol^{-1}) was used in two different quantities: 200 and 400 µL. In the first case, it generates 86.49 mg of aminated-silica (SiO_2-NH_2) while the last one produces 172.98 mg.

Then, the total composition in the former case (200 µL of APTES: CCM/SiO_2-NH_2-200) is: 0.96 mg CCM (considering an entrapment yield of 32%) + 101.4 mg SiO_2 + 86.49 mg SiO_2-NH_2. The overall mass percentage of CCM is 0.5%. For the second one (400 µL of APTES: CCM/SiO_2-NH_2-400), the composition is: 2.25 mg CCM (considering an entrapment yield of 75%) + 101.4 mg SiO_2 + 172.9 mg SiO_2-NH_2. The overall mass percentage of CCM is 0.8%.

Then, for biological tests, 32 mg of CCM/SiO_2-NH_2-200 were diluted in 1.75 mL that makes 18.28 mg mL^{-1} of nanoparticles that corresponds to 0.092 mg mL^{-1} of CCM. Similarly, 13 mg of CCM/SiO_2-NH_2-400 were added to a volume of 1.75 mL that makes 7.42 mg mL^{-1} of nanoparticles that corresponds to 0.060 mg mL^{-1} of CCM.

References

1. Coenen, S.; de Kruif, C. G.; *J. Colloid Interface Sci.* **1988**, *124*, 104.