Encapsulation of BSA in hybrid PEG hydrogels: stability and controlled release

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Figure 1: Temperature effect on the kinetics of polymerisation of Si-PEG oligomers at pH 7.4, after hydrolysis at pH 4.9 during 3 hours. Measurements done on sols at [Si-PEG] = 20 % wt/v, in 1 ml high quality polystyrene cuvettes using a zetasiser, Malvern Instrument.

Wet materials



Dry materials



Figure 2: Peak force QNM of dried (up) and hydrated (down) hydrogels. This figure showed the strutures of all the materials prepared in this study. It revealed elongated structures which length was improved by the drying process.



Figure 3 : TGA traces of the different materials. See on the left the weight loss below 120°C ascribed to the water residual contain at the end of the material treatment. W24G and W6G exhibited large water contain in the range of 70-80 % weight loss. In contrast, after the drying process under vacuum,



b)



Figure 4: Circular dichroism deviation at 222 nm, $[\theta]_{222 \text{ nm}}$, in function of temperature a) Examples of CD spectra recorded at 20°C.

b) Ellipticity [θ]_{222 nm} in function of the temperature for BSA loaded in Si-PEG hydrogels (20%wt/v) at different conditions and references. BSA solution □ in PBS, ∞ in PEG ; BSA loaded in ∞ D24G, □ A24G, ○ W24G, ∞ D6G, ○ W6G.

a)

1/ Hydrogels W24G



3/ Hydrogels W6G



2/ Hydrogels D24G



1 y = 5E-05x + 0,0118 0.9 $R^2 = 0,9645$ 0.8 v = 3E-05x + 0.0259R² = 0,9366 0.7 8 0,6 y = 4E-05x + 0,0377 M,/M $R^2 = 0,9248$ Regime 02 0,5 y = 6,22E-04x - 7,74E-01 0.4 0 Regime 01 $R^2 = 9.95E-01$ 0.3 4,32E-04x - 4,58E-01 R² = 9,86E-01 0.2 0.1 C y = 4,63E-04x - 5,20E-01 8 0 R² = 9,94E-01 2500 3000 2500 0 500 1000 1500 2000 t^{1/2} (s^{1/2}) • [PEG]=20% • [PEG]=25% • [PEG]=30%

Figure 5: BSA release plot fittings – Determination of the diffusivity ratio

Fick diffusion was validated when linearity was reached (with $r^2 \ge 0.92$ and $M_t/M_0 \le 0.6$) for the function $M_t/M_0 = f$ (t^{1/2}), where M_t is the concentration of solute released in the bulk for each sampling time, and M_0 the solute concentration at infinite time. The presence of linear parts was attributed to Fick's diffusion of the solute, meaning BSA, though the hybrid hydrogel material. The absence of linear parts in this model was ascribed other mechanism driven the BSA release (D24G).

4/ Hydrogels D6G