Exercise 10: Drug Delivery and Biocompatibility

21/05/2015

Question 1

Magnetic nanotubes were synthesized by atomic layer deposition. The nanotubes exhibited 350 nm, an average diameter of 80 nm and a wall thickness of 5 nm. In order to load them, 1 mg of the nanotubes was dispersed in an aqueous solution containing 5 ml of 70 g l^{-1} of a drug. After the loading was complete, the excess drug was removed.

a. Calculate the amount of drug inside a nanotube and the total amount of drug carried by 1 mg of those nanotubes. Assume that the contribution from adsorption in the inner and the outer surface of the tubes is negligible. The density of the nanotube material is 5.175 g cm^{-3}.

b. Table 1 shows the fluorescence values of solutions containing different concentrations of the drug. From this data, determine the calibration curve.

F (counts)	300	1000	2500	4100	7900
C (mg l^{1})	0.7	2.3	6.8	11.4	22.8

Table 1

c. Table 2 gives the cumulative fluorescence values as a function of time for a drug release experiment. For this experiment, 1 mg of nanotubes was placed in 5 ml of water and fluorescence was measured for the given time intervals. Plot the concentration of drug as a function of time and determine if all the nanotubes have released all of the drug.

F (counts)	800	1600	2100	2400	2700	2700
t (min)	15	30	60	120	180	240

Table 2

Question 2

Segmented Au-Ni nanopillars are used in cell studies and are incubated with fibroblasts for a period of 2 weeks. During this incubation period, cell viability is measured for different incubation times and the results are shown below. At the end of the experiment, a chemical analysis performed on the cell media shows free Ni^{2+} ions. Discuss the interaction between the nanopillars and cells. What is happening to the nanopillars? Could these nanopillars be considered biocompatible?

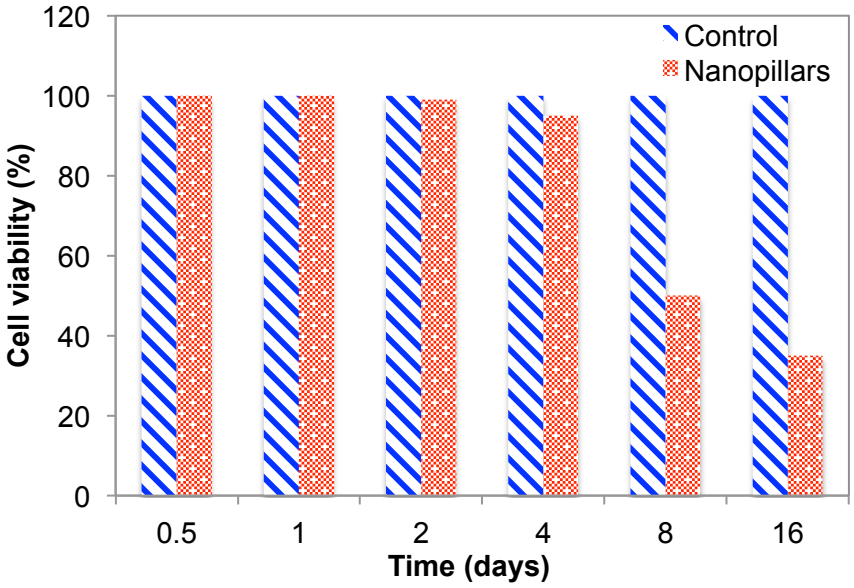

Figure 1