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Biomaterials - Tissue Interactions

Homework #5

1. A new company, Polycoat, offers a service to orthopedic companies in which they apply a polymer coating, 100 nm thick, to cobalt-chromium alloy prostheses. The coating contains calcium phosphate particles, 10 nm in diameter. The putative benefits of the coating are: 1) bone will bond to it and 2) water absorbed by the polymer will slowly dissolve the particles thereby releasing calcium, which will favorably affect nearby osteoblasts. You have been hired by an orthopedic company to help them analyze Polycoat-coated prostheses and review data from Polycoat.
   a. It is important to verify that the calcium phosphate particles are within 5 nm of the surface of the Polycoat coating. Given that you can employ only one of the following methods which would you chose and what would you measure: infrared spectroscopy, ESCA, X-ray diffraction? Explain.
   b. Polycoat states that there should be no concern about loose calcium phosphate particles on the surface of the coating because their conventional light microscopy studies have not revealed particles on the surface. Is there anything that you would recommend relative to this issue?
   c. In reference to the hydrophobic-hydrophilic character of the coating, Polycoat determined the contract angle of water on the surface of the coating. What information would you request about the conditions under which the contact angle measurement was made? What type of contact angle measurement would you require for this coating?

2. The silicone elastomer used to fabricate breast prostheses is normally filled with noncrystalline silica particles, 2 nm in diameter, to give it strength. A question has been raised about whether such particles are actually in a sample of the prosthesis given to you for study. Comment about the appropriateness of each of the following methods for determining if such silica particles are in your sample.
   a. Scanning electron microscopy
   b. Transmission electron microscopy
   c. X-ray diffraction

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