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Abstract:

For coating of medical implants, two different strategies have been evolved, either films which can be decomposed after a certain time of impact, or "eternal" layers. Both types can be composed as a homogeneous film or a heterogeneous sandwich layer, which have the charm that the same coating layer can be used not only to protect different pharmaceutical depot layers on top of different substrates but also to allow a retarded emission of drugs, which can be adjusted by its porosity. Our coatings are made of FDA-passed poly-(p-xylylene), or parylene, PPX. It is employed it two systems: for coronary stents, or in antibacterial urinary catheters. In the first case, it protects a restenotic drug which is applied on top of a plasma-roughened metallic surface, in the second application, the porous cap layer protects a silver film, which is deposited on the interior walls of a catheter in a random zebra-stripe design without application of a mask technology. Its morphology can be adjusted by the conditions of preparation.

For capillaries, one challenge is the homogeneous thickness on the interior sidewall from the mouth to the dead end of the capillary, which has been solved by application of a temperature seesaw: Since condensation is an exothermic process, application of the principle of Le Chatelier moves the equilibrium of diffusion with deposition loss to the side with higher internal energy, i. e. to the vaporous phase, thereby equalizing the deposition rate, downward at the mouth and upward at the dead end.

The porosity of the cap layer can be adjusted by its thickness between zero and approx. 1000 nm [1]. Especially for the Gorham method, which is widely applied for the deposition of PPX, thicknesses below 1 μm are difficult to obtain. Applying a method which resembles Papin's principle, this challenge could also be met [2].

The porosity is judged by atomic force microscopy (AFM) and electrochemical impedance spectroscopy (EIS), the loss rate by ICP-OES and polarography, the medical impact by measuring the optical density and applying a growth inhibition test [3]. One of the medical challenges is the confirmation of the minimum inhibition concentration of these compound layers.

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[2] G. Franz and F. Schamberger,. J. Vac. Sci. Technol. A 31, 061602 (2013)

[3] H. Heidari Zare, St. Sudhop, F. Schamberger, and G. Franz, Biointerphases 9, 031002 (2014)