

NANOSTRUCTURED SMART DRUG DELIVERY COATINGS

Karin Dittmar, Heinrich Hofmann

Laboratory of Powder Technology, EPFL, Lausanne, Switzerland

Arnaud Tourvieille, Laurent-Dominique Piveteau

Debiotech SA, Avenue de Sévelin 28, 1004 Lausanne, Switzerland

INTRODUCTION

Failure of a therapy based on systemically administered drugs has many origins, but one classical reason is the inability to achieve the required dose at the site to be treated. This effect is especially true for drug treatments following implantations.

In the orthopaedic field a large number of total hip replacements failures have been observed on patients younger than 60. This is mainly due to peri-implant bone loss occurring during the first two years after implantation. In order to treat these failures, implants with a coating containing a drug can be used. For example bisphosphonate is known to decrease the osteoclastic bone resorption activity and therefore reduce the risk of total hip repladement failure.

TECHNOLOGY

The use of thin and nano-structured ceramic coatings for orthopaedic medical implants is well established. These “nano” materials have shown advantages in terms of wear and corrosion resistance. However, as ceramics are dense materials, most of these coatings are only used as inert protective layers.

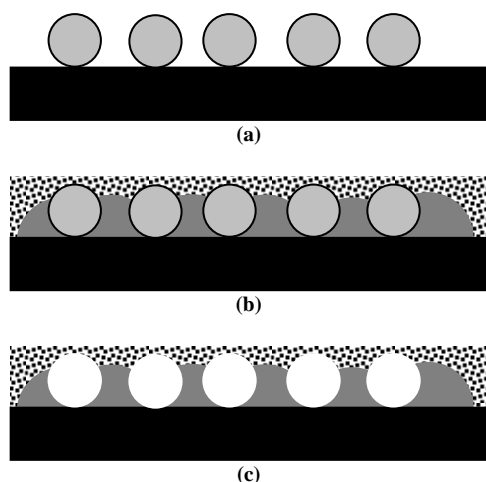


Figure 1: Processing steps. (a) Deposition of the polymeric template, (b) coating of the substrate with the ceramic, (c) thermal treatment to remove the template

We present here a new technology that combines the inertness and stability of ceramics with a high drug loading capacity.

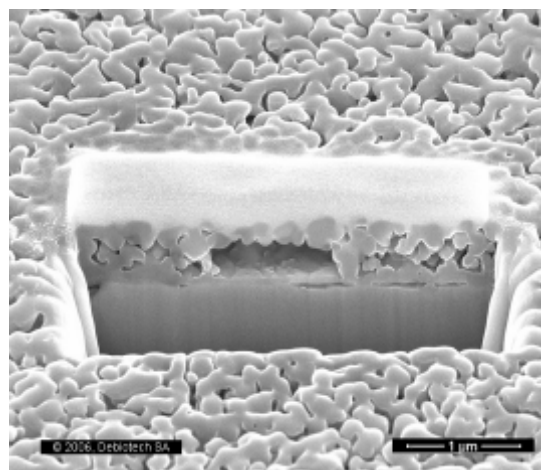


Figure 2: Structured coating with a micro-sized cavity for drug loading and a nano porous membrane for drug release control.

In order to store and release a drug over a few days to a few weeks, the coating combines two porosities: one of large size acting as a reservoir and where the drug is stored and another of size similar to the released molecules that acts as a diffusion membrane. Micrometer size cavities are created by depositing a template onto the implant. This template is made of mono disperse polystyrene particles that are deposited by dip coating onto the substrate (Figure 1(a)). It is then covered by the ceramic while the diffusion membrane is produced by adding a second layer of porous ceramic (Figure 1(b)). The nano porous membrane is created by a stacking of ceramics nano particles. Finally the template materials are removed by a thermal treatment and cavities are created (Figure 1(c)). The final coating has a thickness between a few hundred of nanometers and a few micrometers (Figure 2). First results on coating fabrication will be presented

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