# Sputtered Porous Columnar Coatings for Non-Polymeric Drug Delivery

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## Introduction

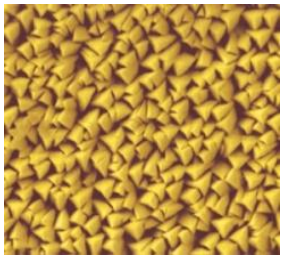
Sputtered porous columnar (SPC) metallic coatings provide a highly attractive platform for polymer-free drug delivery from vascular stents.

The coatings are biocompatible, corrosion resistant, durable and can significantly enhance the radiopacity of the entire stent framework.

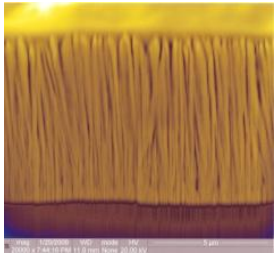
Cylindrical magnetron sputtering produces a low energy deposition process that maintains the original stent properties and achieves excellent coating adhesion.

## SPC Coating Structure

- Individual non-connected columns
- Continuous and open pore space (every pore is open to the surface and connected to neighboring pores)
- Total porosity is approximately 20%
- Pore widths range from 5 to 30 nm



Top View

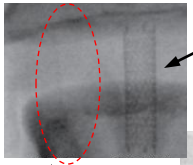


Side View

10 μm SPC Tantalum coating on SS

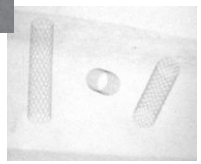
## Tantalum SPC Coating on Nitinol

### Radiopacity Enhancement



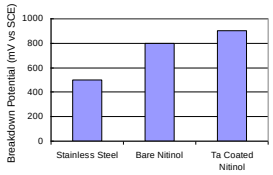
Coated Nitinol stent, 10 μm SPC Ta

Uncoated Nitinol stent



Nitinol stents with 10 μm SPC Ta

### Corrosion

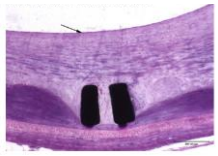



Breakdown potential for bare and Ta coated stents

The coating did not adversely affect the corrosion performance of the Nitinol.

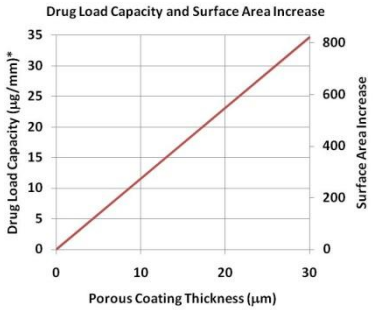
### Histology

Typical 180 day porcine histopathology



There was no significant difference in the stenosis, intimal thickness and inflammation score between coated and uncoated stents in both the 30 day and 6 month studies.

## Drug Loading

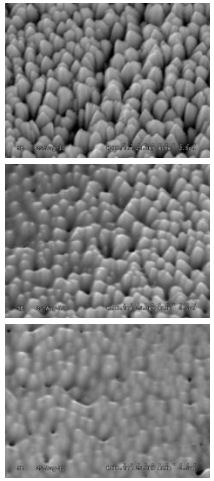



* Coronary stent, 5 mm²/mm and fully filled pores

- Pore volume provides a protected reservoir
- Open, interconnected pores load easily

### Sirolimus Loaded into SPC Tantalum

Increasing Drug Load



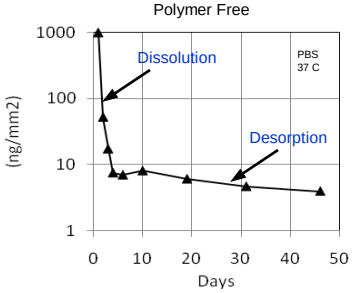
## Drug Release

Drug release kinetics are described by a first phase controlled by drug dissolution and a second phase controlled by drug desorption.

The transition between these two phases occurs when the drug film approaches a monolayer in thickness.

The relative amount of drug released in each phase depends on the initial drug film thickness.

The very high surface area of a nanoporous columnar coating makes it possible to deliver a significant amount of drug during the desorption phase.




Sirolimus release from 20 μm SPC Cr coating

## SPC Coating Summary

- Polymer free drug delivery
- 30 day+ release
- Open nanoporous structure
- Loads easily with drug
- Excellent coating integrity
- Enhanced radiopacity
- Large drug capacity
- Ta, Cr, CoCr demonstrated
- Other metals/alloys are possible
- Multilayer structures are possible