May 9, 2007 (Version 2.0)

BN 1333

Thickness and Uniformity of Silver Antimicrobial Coatings

Discussion

Many medical devices, such as wound dressings and urinary catheters, are coated with silver (Ag) based antimicrobial coatings to reduce the risk of infection. Thickness and uniformity are important to the performance of these coatings.

Figure 1 shows photomicrographs from a focused ion beam (FIB) cross-section of a Ag-based antimicrobial coating on a polyethylene (PE) catheter. A backscattered electron (BSE) image overview of the cross-section is shown on the left, with a higher magnification SEM image of the coating on the right. The dotted lines indicate the thickness of the Ag-containing layer, which averages 0.35 µm. The grain structure of the coating is also visible in the right hand image. The coating layer is bounded by the underlying polyethylene and by a sacrificial platinum (Pt) layer deposited in the FIB/SEM instrument.

BSE images from a different Ag-based coating are shown in Figure 2. As in the previous example, a Pt layer was deposited on top of the film and the underlying PE is beneath it. In the image on the right, a portion of the opposite side of the FIB cut is still visible. The layer thickness is indicated by the double-headed arrows. The image clearly shows two phases in the coating that vary in thickness in different areas. The average thickness of the top layer is 0.5 µm, while the lower layer averages approximately 1.2 µm.

The FIB/SEM Technique

An FEI 830 DualBeam™ SEM/FIB (focused ion beam) can be used to prepare cross sections of biomedical coatings in *situ* using the instrument's focused ion beam and then image the resulting cross sections using the instrument's field emission SEM. The focused ion beam is a Ga liquid metal ion gun (LMIG) that impacts the sample normal to the surface and can be focused to a spot as small as 70 Å. The focused ion beam can be rastered in a user-defined pattern over larger areas to selectively sputter and mill away the surface. By flooding the surface with specific gases, e.g., Pt-organometallic, XeF_2, or H_2O, during ion or electron bombardment, new material can be deposited (Pt metal for charge control) or reactive species can be created that selectively etch the surface and delineate specific features.

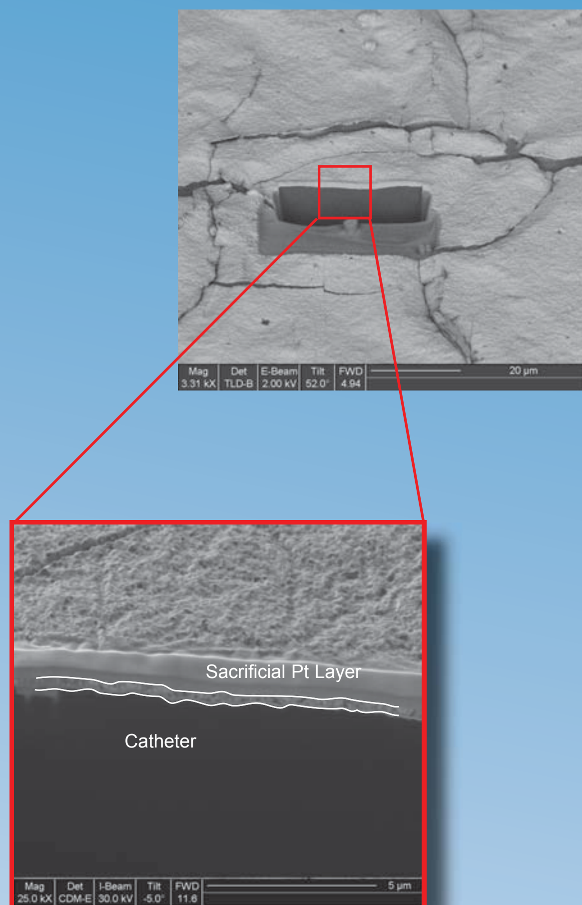

Figure 1. BSE (left) and SEM (right) images from Ag-based coating on PE catheter.

This type of etching is restricted only to areas bombarded by the ion or electron beam. The combination of both unselective ion milling and selective etching using reactive species creates a very powerful sample preparation tool. The instrument's field emission SEM allows imaging of the sputter crater (the cross-section) during and immediately after preparation of the section. The SEM has an ultimate resolution of 20-30 Å, allowing the measurement of coatings as thin as 100 Å.

Other Applications of FIB/SEM

The Dual Beam FIB has also been used to measure the thickness and uniformity of multilayered organic compounds and organic coatings on coronary stents.

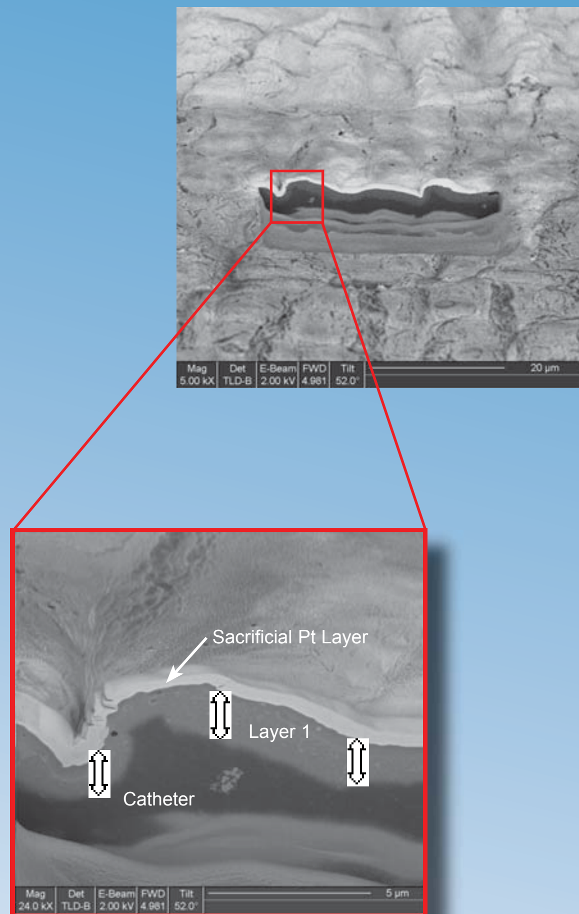

Figure 2. BSE images from a second coating on a catheter.

United States Locations

Tempe, Arizona
+1 480 239 0602 info.az@eaglabs.com
+1 602 470 2655 fax

Sunnyvale, California
810 Kifer Road
+1 408 530 3500 info.ca@eaglabs.com
+1 408 530 3501 fax

1135 E Arques Avenue
+1 408 738 3033
+1 408 530 3035 fax

785 Lucerne Drive
+1 408 737 3892
+1 408 737 3916 fax

Peabody, Massachusetts
+1 978 278 9500 info.ma@eaglabs.com
+1 978 278 9501 fax

Chanhassen, Minnesota
+1 952 828 6411 info.mn@eaglabs.com
+1 952 828 6449 fax

East Windsor, New Jersey
+1 609 371 4800 info.nj@eaglabs.com
+1 609 371 5666 fax

Syracuse, New York
+1 315 431 9900 info.ny@eaglabs.com
+1 315 431 9800 fax

Raleigh, North Carolina
+1 919 829 7041 info.nc@eaglabs.com
+1 919 829 5518 fax

Round Rock, Texas
+1 512 671 9500 info.tx@eaglabs.com
+1 512 671 9501 fax

International Locations

Shanghai, China
+ 86 21 6879 6088 info.cn@eaglabs.com
+ 86 21 6879 9086 fax

Tournefeuille, France
+ 33 5 61 73 15 29 info.fr@eaglabs.com
+ 33 5 61 73 15 67 fax

Frankfurt, Germany
+ 49 (0) 693053213 info.de@eaglabs.com
+ 49 (0) 69307941 fax

Tokyo, Japan
+ 81 3 5396 0531 info.jp@eaglabs.com
+ 81 3 5396 1930 fax

HsinChu, Taiwan
+ 886 3 5632303 info.tw@eaglabs.com
+ 886 3 5632306 fax

Uxbridge, United Kingdom
+ 44 (0) 1895 811194 info.uk@eaglabs.com
+ 44 (0) 1895 810350 fax