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Fractal modelling of images of crystalline growth on bioactive surfaces.

Objective:
The project goal is the quantitative characterisation of the growth of hydroxy-apatite films and cellular tissue over surfaces coated with bioactive materials, using for that purpose fractal modelling of the respective images. It is a highly interdisciplinary project, involving the co-operation of PSI and BID groups, namely mathematicians, engineers (materials and electronics) and biologists.

Methods and Results:
A set of SEM images of growth of hydroxy-apatite films over bioactive surfaces were collected at the Materials Centre of Oporto University. The sample in Figure 1 shows the hydroxy-apatite growth over a bioactive surface after 3 days of immersion in a human fluid simulated solution.

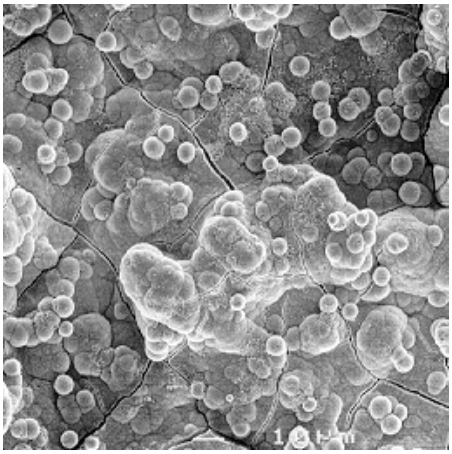
Figure 1.

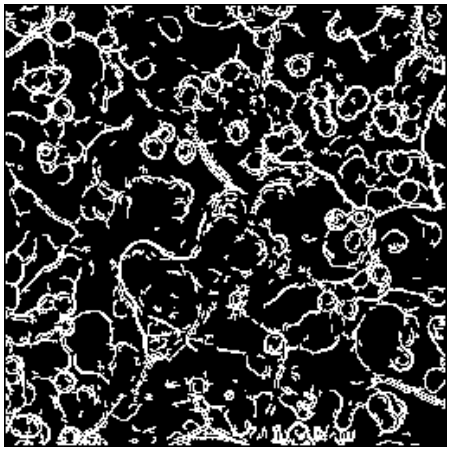
Figure 2.

At the present, we have developed a set of tools for edge detection and image segmentation. Currently, we are using an edge detection approach (see figure 2), and a fractal characterisation of the edge map based on the computation of generalised fractal dimensions.
Using this methodology, we found out that the set of generalised fractal dimensions are reproducible, i.e. for a given bioactive surface the set of dimensions estimated from images from distinct locations are found to be statistically equal.
We are now investigating the ability for bioactive surface classification using this set of fractal dimensions.

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Other Collaboration: CEMUP-Centro de Materiais da Universidade do Porto.
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Duration: ~ 4 years (July 1997/ July 2001).