Correlation of Synchrotron-Based Infrared and X-Ray Imaging

Beamline: U10B, X26A

Technique: infrared microspectroscopy, x-ray fluorescence microprobe

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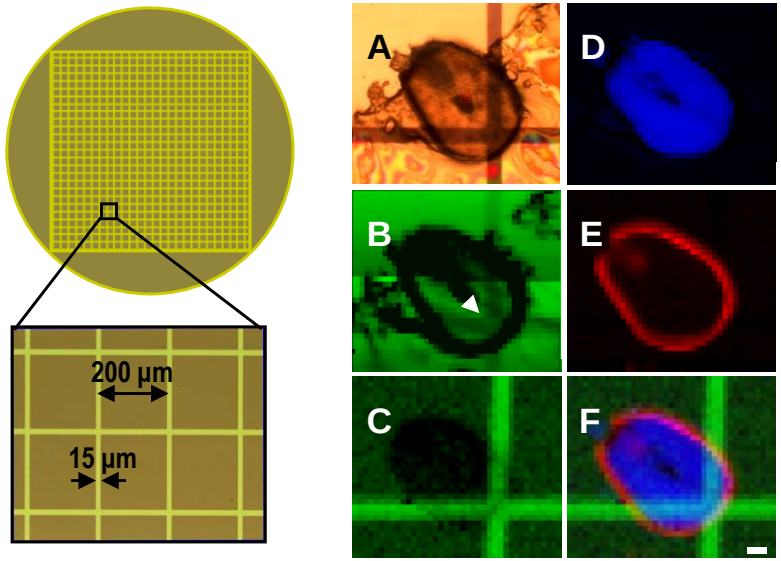
Motivation: In many diseases, both the organic and metal ion compositions are altered. However, due to the technical difficulties such as sample preparation, sample substrates, and image registration, most of the studies utilize either FTIRM or SXRF microprobe, but not both, and therefore miss information about the relationship between the alterations of the organic and metal contents. In this work, we develop a gold-patterned sample substrate for co-registering the FTIRM and SXRF images microprobe.



(Left) Schematic (top) and light microscope image (bottom) of the patterned substrate. (Right) Cross-section of human hair (A) under visible light illumination. (B) Au FTIRM reflectivity image. (C) Au SXRF image. (D) FTIRM image of the protein content (E) SXRF image of copper content. (F) RGB color image illustrating the protein from FTIRM (blue channel) and Cu content from SXRF (red channel) in the tissue. Au SXRF microprobe is placed in the green channel. Scale bar is 20 microns.

Results: We present the development of the gold grid patterned sample substrate with the applications to paraffin-embedded metalloprotein crystals, Alzheimer's disease, and hair composition. We show that FTIRM and SXRF images can be correlated precisely, with a spatial resolution of less than one pixel, i.e. 2-3 microns. By combining FTIRM and SXRF microprobe imaging on the same sample utilizing this sample substrate, a more complete picture of many disease states and exposure to environmental contaminants can be achieved by directly correlation the organic and trace metal ion distribution in the tissue.