Technology Brief

Fiducial Marker for Correlating Images

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Description:

A fiducial marker that effectively correlates images of x-ray fluorescence and infrared spectroscopy analyses.

A thin sample is placed on top of a metallic marking grid possessing a reflective and x-ray-sensitive grid pattern. The sample can include but is not limited to biological, plant, rock, mineral, polymeric, or tissue. The grid can be any metal but gold is preferred. The grid pattern is composed of one or more layers. Specifically, where multiple features of a sample are involved in the analysis, the grid has two layers whereas one layer is useful for correlating an analytical image with the light path of a microscope objective. In the case of the single layer, the light path of the microscope objective is not otherwise visible by the analytical instrumentation or modality producing the analytical image. Therefore, the fiducial marker with its marking grid permits the correlation of the light path with the analytical image.

When the grid has two layers, each layer has a different thickness (i.e., a major and minor layer of 25 nm and 12 nm, respectively) that can be differentiated by infrared spectroscopy reflectivity. A first analytical image of the sample is taken, preferably by x-ray fluorescence, which is then spatially overlapped by a second image, preferably infrared spectroscopy. The two images are then co-registered and correlated by custom software to create a single image of both analyses by aligning the coordinate systems of each image. The utilization of a fiducial marker in this technique can be used in the imaging and correlation of organic components detected by Fourier transform infrared microspectroscopy (FTIRM) with trace elements detected by x-ray fluorescence (XRF).

Technical & Commercial Merit:

Fourier transform infrared microspectroscopy (FTIRM) and x-ray fluorescence (XRF) are becoming increasingly popular for imaging the organic and trace metal composition of biological materials, respectively, without the need for extrinsic labels or stains. In many

disease states and instances of environmental contamination, alterations in the organic and metal ion compositions are exhibited. Thus, there is a need for a method that precisely obtains pertinent information about the relationship between alterations in the organic and metal content of a sample. One means of remedying this situation is to register one image space to another image space by fiducial markers, which are points in space that align the coordinate vectors of two separate images. This fiducial marking grid fulfills such a need because it can correlate one analytical image with a second analytical image through the combination of FTIRM and SXRF microprobe imaging. In addition, the fiducial marker is also capable of correlating the light path of a microscope objective with the analytical image produced by an analytical instrument or modality in cases where the light path is not otherwise visible by the analytical instrument.

Competitive Advantage:

This new fiducial marker is ideal for those in the medical or research fields involved in imaging more than one aspect of a sample. This technology correlates the images of x-ray fluorescence and infrared spectroscopy, which has direct application to diagnosing and study various disease pathologies. This is accomplished with a spatial resolution of less than one pixel, notably 2-3 microns. Previous methods focused on either x-ray or infrared spectroscopy, and not both. As a result, information about the relationship between the alterations of the organic and metal contents, which plays a vital role in understanding the origins of diseases such as Parkinson's disease, Alzheimer's disease, and cancer, can be missed. For example, the combination of infrared spectroscopy and x-ray fluorescence images of Alzheimer's disease brain tissue will simultaneously yield defective amyloid proteins and abnormal levels of Fe, Cu, and Zn. The current fiducial marking grid, however, can study both pathological symptoms by precisely overlapping the results of the imaging modalities. This advantageous correlation will ultimately allow one to create a more complete picture of many disease states by directly integrating the organic and trace metal ion distribution in the sample of interest. Further, the fiducial marker can be used to correlate the light path of a microscope objective with an analytical instrument or modality in situations where the light path is not visible by the analytical instrument.