MICRO X-RAY FLUORESCENCE IMAGING OF PHARMACEUTICAL TABLET FORMULATIONS

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The analysis of the distribution of pharmaceutical materials in tablet formulations, such as drugs and matrix elements, is critical to product performance and are used in such areas as quality control, impurity testing, and process monitoring. Techniques used for formulation analysis have included HPLC, UV, laser-induced breakdown spectroscopy, atomic force microscopy, Raman spectroscopy, IR spectroscopy, and total reflection x-ray fluorescence.

Recently imaging techniques, such as Raman, near-IR, and fluorescence imaging, have become popular for “visualization” of pharmaceutical formulations, allowing for spatial and chemical composition information to be obtained simultaneously. These methods have been primarily focused on “chemical imaging”, or spatial analysis of the molecular characteristics of the tablet formulation. However, elemental species are also an important part of pharmaceuticals. For example vitamin tablets, such as Vitamin B-12 or iron supplements, contain metals that are integral to their function. Similarly, monitoring of potential drug contamination by inorganic impurities, e.g. halogens, arsenic, and the heavy metals is also important to pharmaceutical quality control.

Micro X-ray Fluorescence (MXRF) elemental imaging offers complementary information to molecular imaging techniques. MXRF can detect elemental composition for a given sample by measuring its characteristic x-ray emission wavelengths or energies. Mesoscale ( > 10 μm²) analysis is achieved through the use of a polycapillary focusing optic in conjunction with a Rh x-ray tube source, which focuses the source x-rays into a nominal spot size of 30-50 μm in diameter. MXRF allows for simultaneous elemental analysis with both quantitative and qualitative analysis of elements Z ≥ Na. It is a nondestructive technique and requires minimal sample preparation.

In this study, MXRF was used for the elemental imaging of various commercial pharmaceutical drug and vitamin supplements. Specifically, elemental composition and heterogeneity were monitored for each different tablet.