XRF Analysis Using Borate Fusion for Characterization of Major Components in Mesoporous Silica Nanoparticles Comprising the Inclusion of Gadolinium

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Materials research and societal needs continue to drive progress in the field of gene therapy. The interest for nanomaterials, such as mesoporous silica nanoparticles (MSNs), has grown quite rapidly in recent decades. Highly porous MSNs with incorporation of Gd$^{3+}$ paramagnetic ions are powerful « positive » MRI contrast agents for quantitative magnetic resonance imaging (MRI). Several different parameters like global composition and surface composition are important to monitor during product development and in performance evaluation and testing of such materials with highly specific properties.

This presentation provides an interesting overview of the x-ray fluorescence (XRF) analytical application which allows to stimulate R&D and manufacturing efforts in connection with mesoporous silica nanoparticles. In this case, a low sample to flux dilution ratio is used for the preparation by borate fusion because in the development phase of the above-mentioned nanomaterials, the amount available for characterization is quite low. In spite of this situation, the sensitivity, precision and accuracy results achieved in relation to the borate fusion/WDXRF analysis method, proved to be above expectations. Additionally, comparing the Gd/Si ratio obtained from the XRF results with the x-ray photoelectron spectroscopy (XPS) results achieved, turned out to be valuable in drawing a conclusion about the distribution of the Gd in the MSN matrix. Finally, all results and parameters relating to sample preparation and the XRF method will be presented and widely discussed.