Univ.-Prof. Dr. Thomas PROHASKA
Chair General and Analytical Chemistry
Montanuniversität Leoben
Franz-Josef-Straße 18
8700 Leoben, Austria

Chemical imaging: characterisation of materials using elemental and isotopic pattern

Imaging techniques have gained increasing importance in all fields of natural sciences for the characterization of materials at the macro and microscopic level. Different analytical methods allow the assessment of structural, physical, chemical and biological parameter not only in 2 and 3-dimensional images but also for the spatiotemporal visualization of surface processes.
Even though the interpretation of data obtained by single methods is partially well established, the chemometric combination of data sets obtained by different methods is still challenging but allows to shed new light on so far invisible information. Different analytical methods provide complementary information, leading to multiple data sets, which have to be combined and compared in a powerful automated reproducible way to filter out the relevant information with scientific evidence.

In selected examples, the potential of the combination of elemental and isotopic pattern analyzed by laser induced breakdown spectroscopy (LIBS) and laser ablation inductively coupled plasma mass spectrometry (LA ICP-MS) with complementary imaging techniques such as diffusive gradient in thin films (DGT) or hyperspectral imaging (HIS) will be highlighted.

For example, the degradation status of historical bone materials was assessed to determine the Sr isotopic composition in biogenic bone material using a combination of solubility profiling, imaging of elemental and isotopic spatial distributions and near infrared hyperspectral imaging.
Another example presents an analytical approach to determine the elemental and isotope fingerprint and visualization of macroscopic non-metallic inclusions based on LA-ICP-MS and 3D microscopy. The earth element and Sr isotopic fingerprints were used to trace the origin of these inclusions.
As novel technique, chemical imaging using the DGT technique in combination with LA-ICP-MS has evolved as a unique analytical tool to assess solute dynamics at sub-mm spatial resolution. The variety of binding agents allows to prepare gels which are selective for a multitude of analytes. The potential of novel DGT LA-ICP-MS techniques is highlighted on selected applications in environmental and materials sciences.