Quantitative true elemental imaging based on the PIXEKLM program package and the nuclear microprobe

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Production of true elemental images using PIXE and the scanning nuclear microprobe is a complex and still challenging problem. Ryan and his co-workers were the first who developed a software package (GeoPIXE) for quantitative mapping, which has been the only available in this field. It is based on a rapid matrix transform method called Dynamic Analysis which directly converts the spectrum vector (**S**) into the concentration vector (**C**) in terms of the matrix Γ: $\mathbf{C}=Q^{-1}\Gamma\mathbf{S}$ (Q is the accumulated charge). This linear equation system allows to produce true elemental images $M_k(x,y)$ by incrementing each image k (at beam position x,y) by Γ_{ki} for each event at channel i.

Based on our Oxford-type scanning nuclear microprobe facility, a few years ago we realized a special μPIXE set-up consisting of an ultra thin windowed (UTW) and a Be windowed Si(Li) X-ray detector. Then with the modification of our PIXEKLM program package we solved the efficiency calibration of the UTW detector and quantitative analysis down to C-K_α line.

The aim of this paper is to present our new software package developed for true elemental imaging. It is based on the above-mentioned ideas and system allowing off-line data processing from list mode files. The Γ matrix is calculated for any sample composition and thickness by the PIXEKLM program package from C to U for K, L and M characteristic X-ray lines. The true elemental images are produced by a frame program, which allows advanced image processing and sophisticated multivariate statistical analysis in order to help the interpretation and presentation of concentration data.