Artificial Neural Networks and Ion Beams for 3D Imaging

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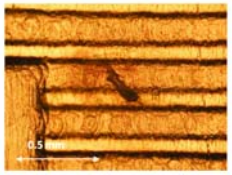
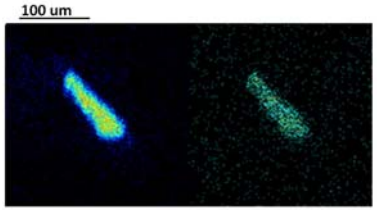
Introduction and Objectives

A nuclear microprobes, together with Ion Beam Analysis (IBA) techniques allow immediate 2D elemental distribution maps.

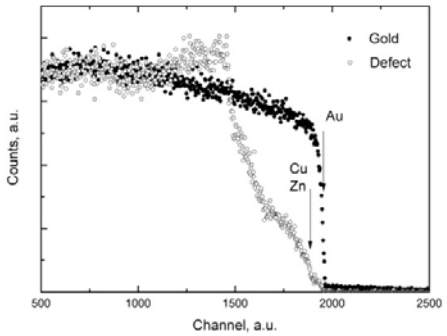
Typically, data from each area scanned is acquired as a 256 x 256 x n pixel matrix, each pixel containing n of the IBA spectra recorded during the experiment.





Gold coin with a defect, with high content of Cu and Zn

To **obtain depth distribution**, fit individually all the 256x256 RBS spectra recorded during a single run is an unacceptable time-consuming task.



Two of the 256x256 RBS spectra from gold and defect regions.

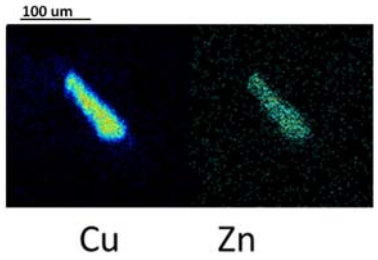
Use Artificial Neural Networks (ANNs), once trained, to analyze the RBS spectra recorded in a single run will open the door to automatically obtain:

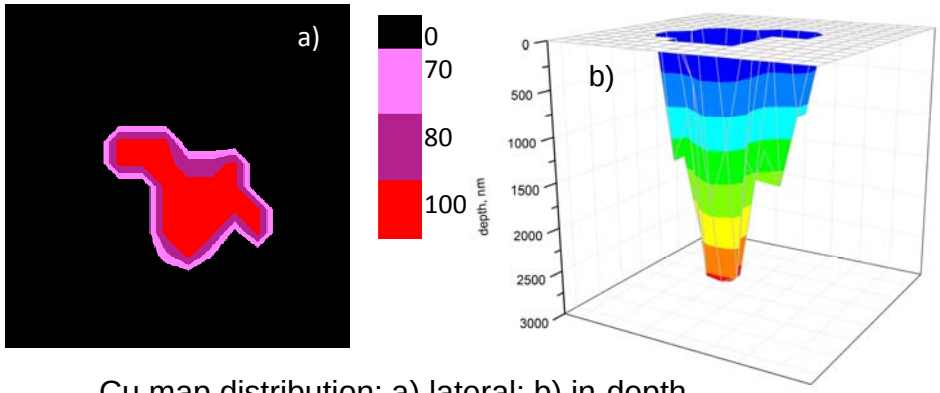
- depth information profile,
- 3D imaging,
- detect inhomogeneous regions in the maps.

We have used Neural Networks and multi-Categorical classification: each category (spectra) has distinct features (“shape” of the RBS spectra) related to the Cu content and profile.

Results

2 MeV Proton beam
Acquisition time: 5 hours
The 256x256 RBS spectra were compressed (16x16) to increase the statistic, then 256 RBS spectra were analyzed.
Time for training: 2 hours
Time for results: < 1 minute.





Cu map distribution: a) lateral; b) in-depth

Conclusions

When using ANN it is possible to visualize the composition and depth distribution in a 3D environment.

Each specific case needs a dedicated and trained ANN.

Time dedicated to train the ANN compensates, since once trained results are obtained almost instantaneously.

Results are useful for a future automated data analysis.

Thank you

Acknowledgments

References
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