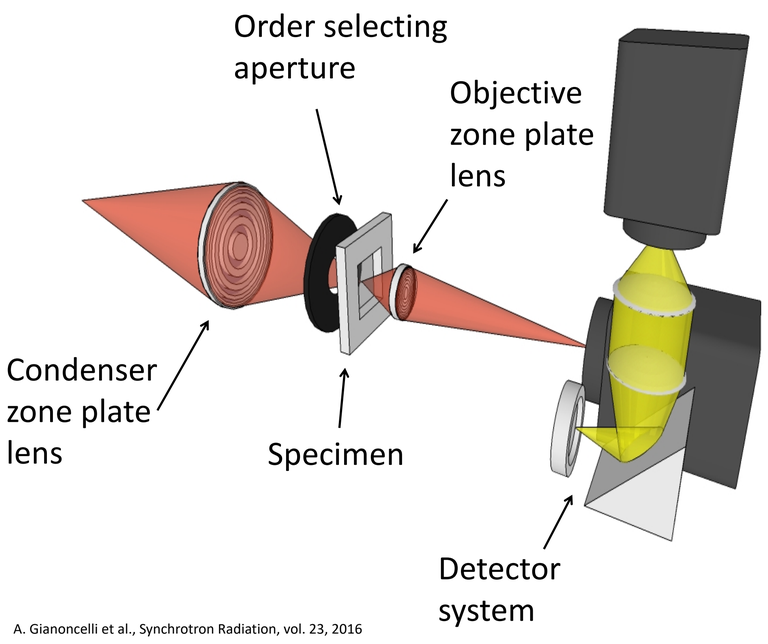
Recent achievements in Life Sciences of the TwinMic soft spectromicroscopy beamline at Elettra

Elettra Sincrotrone Trieste

A. Gianoncelli[1], M. Altissimo[1], D.E. Bedolla[1], G. Kourousias[1]

[1]Elettra, Sincrotrone Trieste, Strada Statale 149, 34149 Basovizza, Trieste, Italy

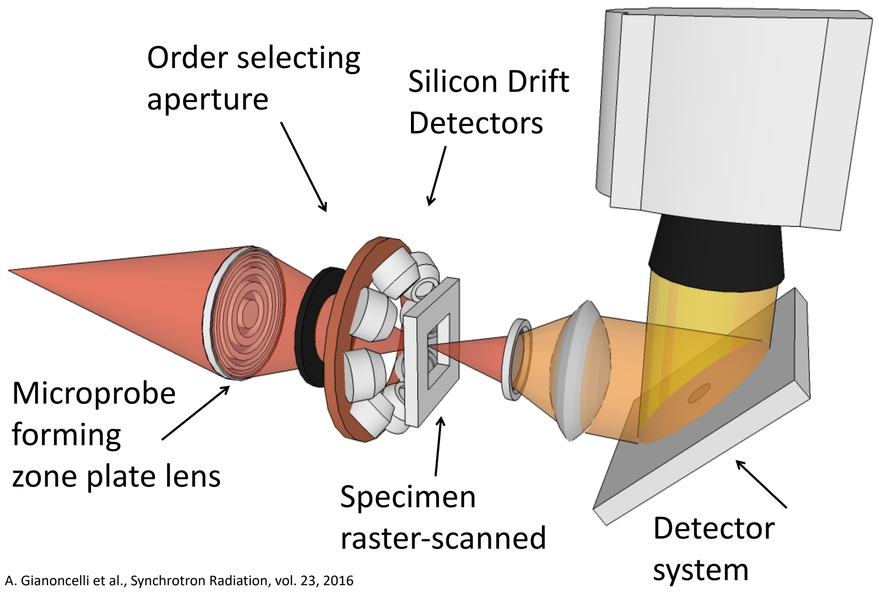
The full-field imaging mode



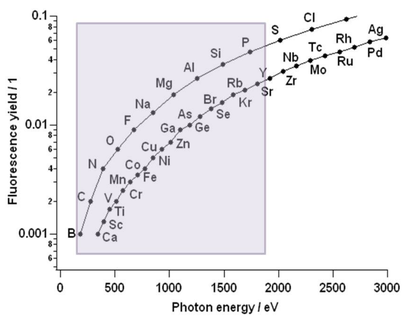
- Similar to conventional visible light microscope
- Analysis of morphology in transmission
- Fast imaging, dynamics, microtomography
- Spatial resolution down to 30nm

A. Gianoncelli et al., Synchrotron Radiation, vol. 23, 2016

The scanning imaging mode (transmission and emission)

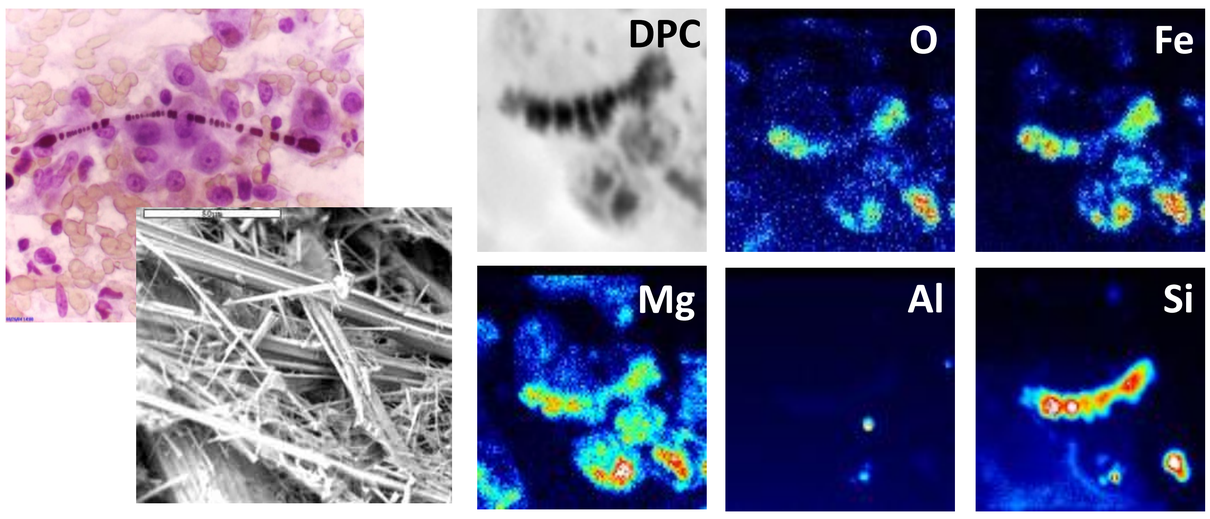


- Simultaneous acquisition of different transmission and emission signals
- Elemental mapping and chemical analysis
- Slower data acquisition
- Spatial resolution down to 50nm



A. Gianoncelli et al., Synchrotron Radiation, vol. 23, 2016

Clinical medicine: Asbestos in lung

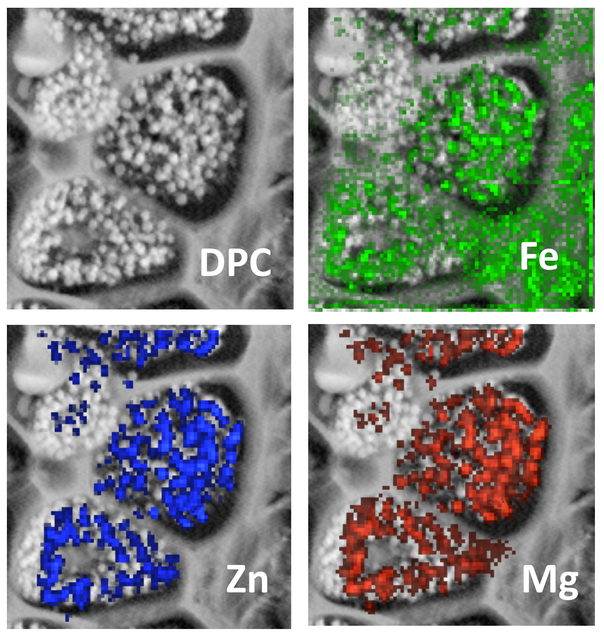


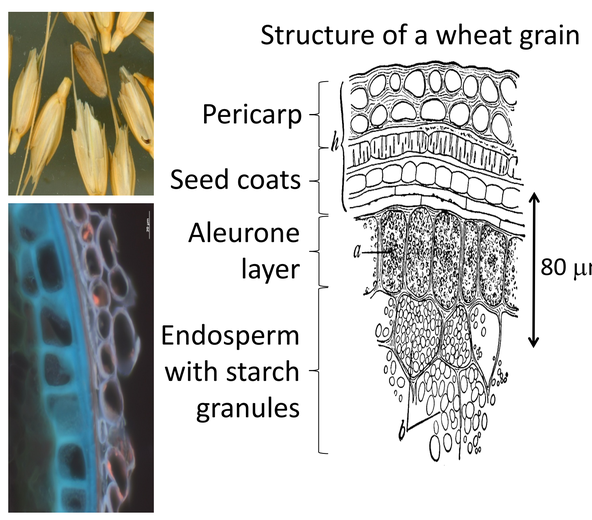
Occupational or environmental exposure to asbestos fibres can cause pleural and parenchymal lung diseases. X-ray microscopy helps to reveal the interaction of lung tissue with asbestos fibres on cellular and sub-cellular level by mapping the Si, Fe and Mg distribution. In particular TwinMic spectromicroscopy has also proven to be valuable in providing new insights on Mg participation in asbestos bodies toxicity.

Collaboration with Pathologic unit of Monfalcone Hospital, Trieste University and Children Hospital Burlo Garofalo IRCCS (Prof. Melato group)

L. Pascolo, A. Gianoncelli, B. Kaulich, C. Rizzardi, M. Schneider, C. Bottin, M. Polentarutti, M. Kiskinova, A. Longoni, M. Melato "Synchrotron soft X-ray imaging and fluorescence microscopy reveal novel features of asbestos body morphology and composition in human lung tissues ", Particle and Fibre Toxicology (2011), 8:7, doi:10.1186/1743-8977-8-7.

Biotechnology: Staple food



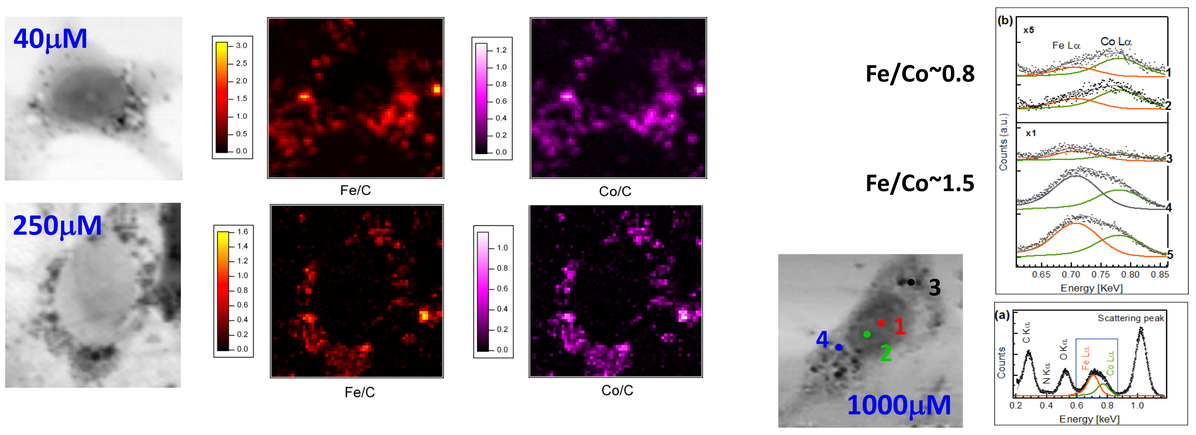


Collaboration with I. Kreft et al, Uni Ljubljana, Slovenia

The assessment of the nutritional availability for a number of the inorganic nutrients in wheat as Zn, Se, Fe or Cu involves the direct analysis of the nutrient itself, its repartition within and between the plant parts, as well as its concentration and competition. TwinMic provides the distribution of trace elements in the aleurone layer of wheat seeds and demonstrates the colocalization of Zn and Mg.

M. Regvar, D. Eichert, B. Kaulich, A. Gianoncelli, P. Pongrac, K.Vogel-Mikuš, I. Kreft "New insights into globoids of protein storage vacuoles in wheat aleurone using synchrotron soft X-ray microscopy", Journal of Experimental Botany, 10.1093/jxb/err090.

Nanotoxicology: NPs in cells



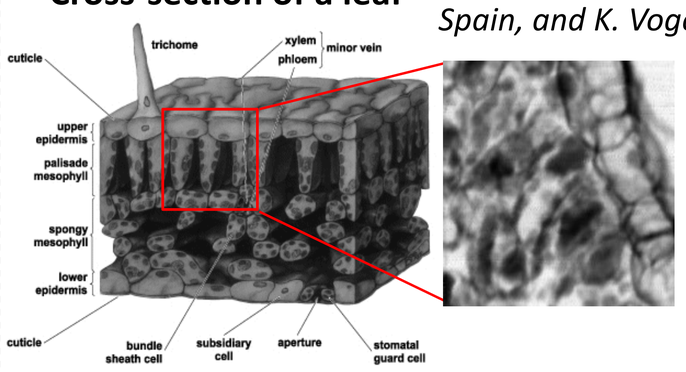
Scientist of IHCP (European Commission, Joint Research Centre, Institute for Health and Consumer Protection) have investigated the interaction of magnetic nanoparticles at single cell levels and in particular, mouse/3T3 fibroblasts exposed to cobalt ferrite ($CoFe_2O_4$) MNPs solutions at different concentrations for 24 h. The SR-XRF chemical maps show that, in cells exposed to low concentrations, $CoFe_2O_4$ MNPs preferentially accumulate in the perinuclear region of the cell, while preserving their chemical content. On the other hand, at high concentrations (?500?M) the XRF spectra reveal the presence of Co and Fe in the nuclear compartment; the increase of Co/Fe ratio also indicates a biodegradation of the MNPs with Co accumulation in the cell nucleus.

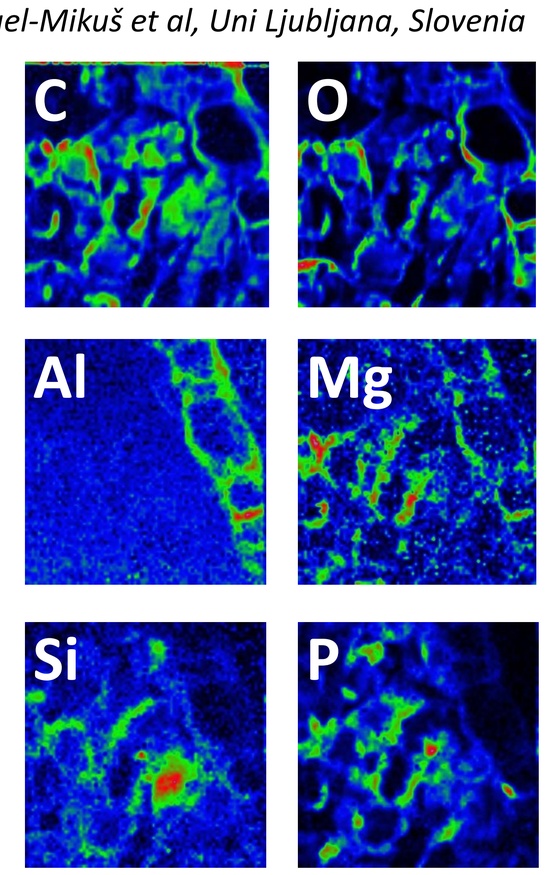
P. Marmorato, G. Ceccone, A. Gianoncelli, L. Pascolo, J. Ponti, F. Rossi, M. Salomé, B. Kaulich, M. Kiskinova, Cellular distribution and degradation of cobalt ferrite nanoparticles in Balb/3T3 mouse fibroblasts, Toxicol. Lett. 207, (2011), 1218-136.

Biotechnology: Al in tea leaves

Cross-section of a leaf

Collaboration with C. Poschenrieder et al, Uni Barcelona, Spain, and K. Vogel-Mikuš et al, Uni Ljubljana, Slovenia





TwinMic low energy XRF capabilities were employed for better understanding the Al tolerance mechanism in Al-accumulating plant species, by studying the localization of Al and other low Z-elements (C, O, Mg, Si and P) in fully developed leaves of the tea plant (Camellia sinensis). The results show that in young tea leaves the preferential accumulation of Al occurs at the end of the transpiration stream, in the epidermal cell walls.

R. Tolrà, K. Vogel-Mikuš, R. Hajiboland, P. Kump, P. Pongrac, B. Kaulich, A. Gianoncelli, V. Babin, J. Barceló, M. Regvar, C. Poschenrieder "Localization of aluminium in tea (Camellia sinensis) leaves using low energy X-ray fluorescence spectro-microscopy", Journal of Plant Research 124 (2011) 165-172.

http://www.elettra.eu/elettra-beamlines/twinmic.html