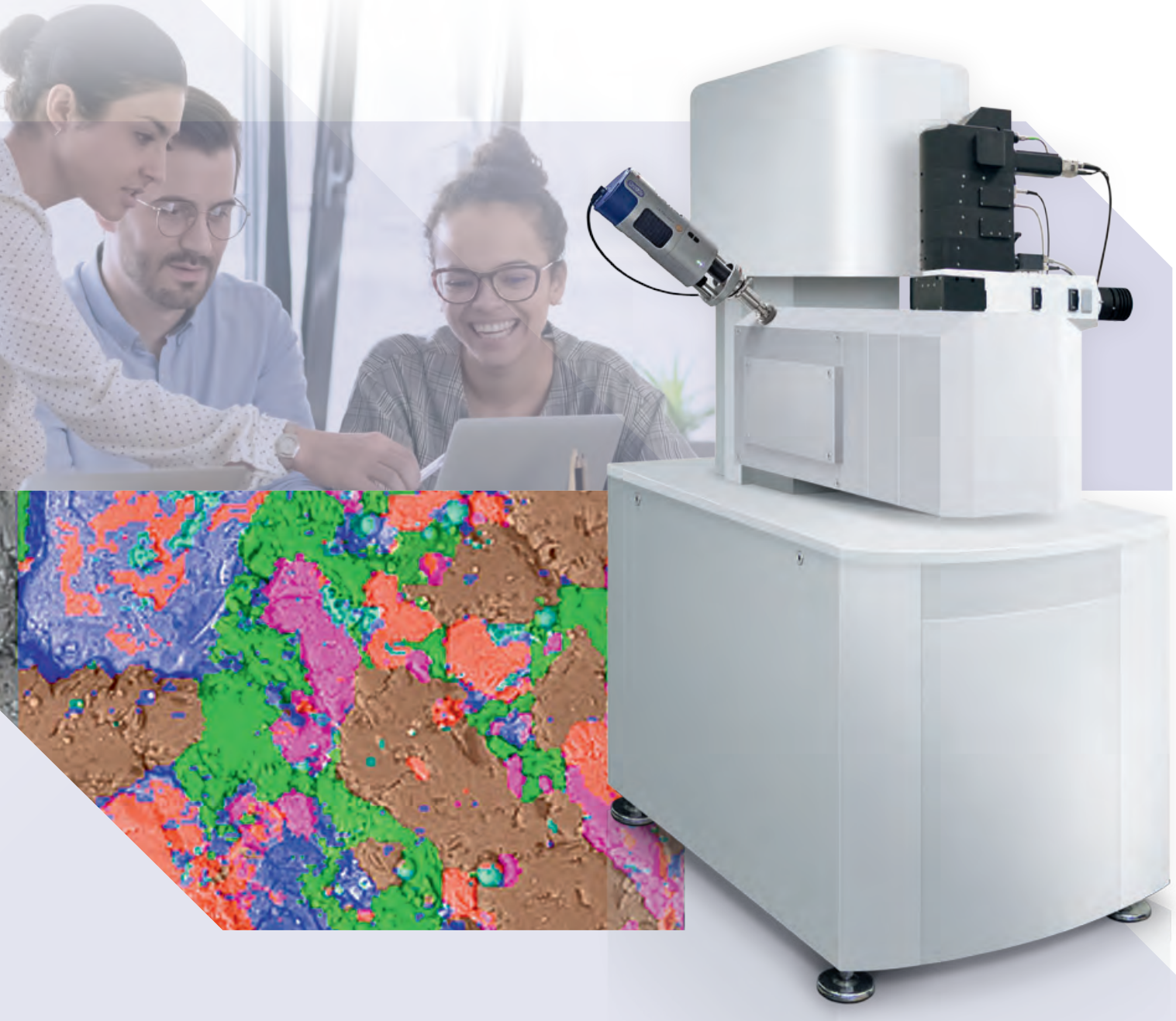
OXFORD INSTRUMENTS

Molecular and Elemental Material Characterisation

Correlative RISE/EDS Microscopy



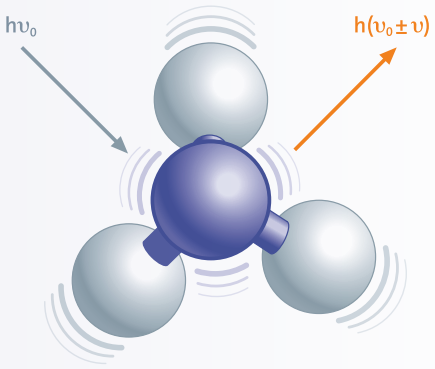
Benefits

Raman Imaging and Scanning Electron (RISE®) microscopy combined with energy-dispersive X-ray spectroscopy (EDS) offers comprehensive sample characterisation at the nanoscale.

	RISE	EDS
Detailed insight	Molecular and bonding information, crystallinity, material stress and strain, crystal orientation	Elemental quantitation and distribution, microstructure and crystal structure
Wide-ranging analysis	Sub-micron and large-area molecular information, 3D chemical imaging	Point analysis, large area mapping, particle analysis
Dynamic vision	Analysis of chemical processes possible	Live Chemical Imaging in real time with AZtecLive
Multimode operation	Independent Raman operation, Raman-SEM image correlation	Simultaneous SEM and EDS data acquisition

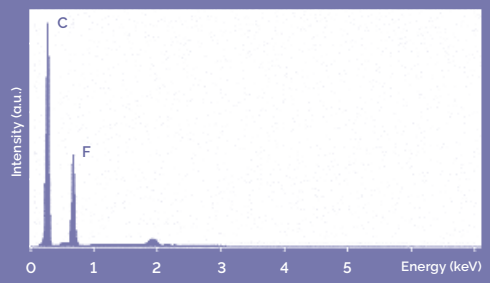
RISE Microscopy

RISE instruments seamlessly integrate confocal Raman imaging and scanning electron microscopy (SEM). They incorporate the sensitivity and non-destructive nature of Raman spectroscopy with the atomic resolution of electron microscopy. Raman imaging enables the identification of molecules, their allotropes and polymorphs, the determination of their orientation, purity and crystallinity, and the detection of strain states. SEM allows for the imaging of surface structures on the nanometer scale.



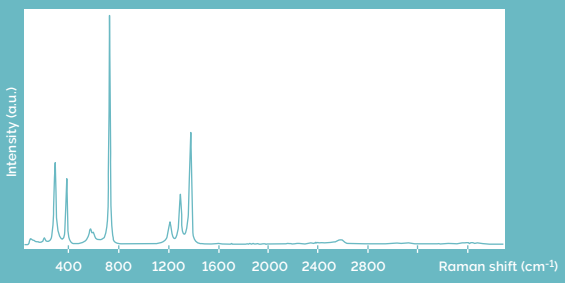
Inelastic scattering of light by a molecule

Technique



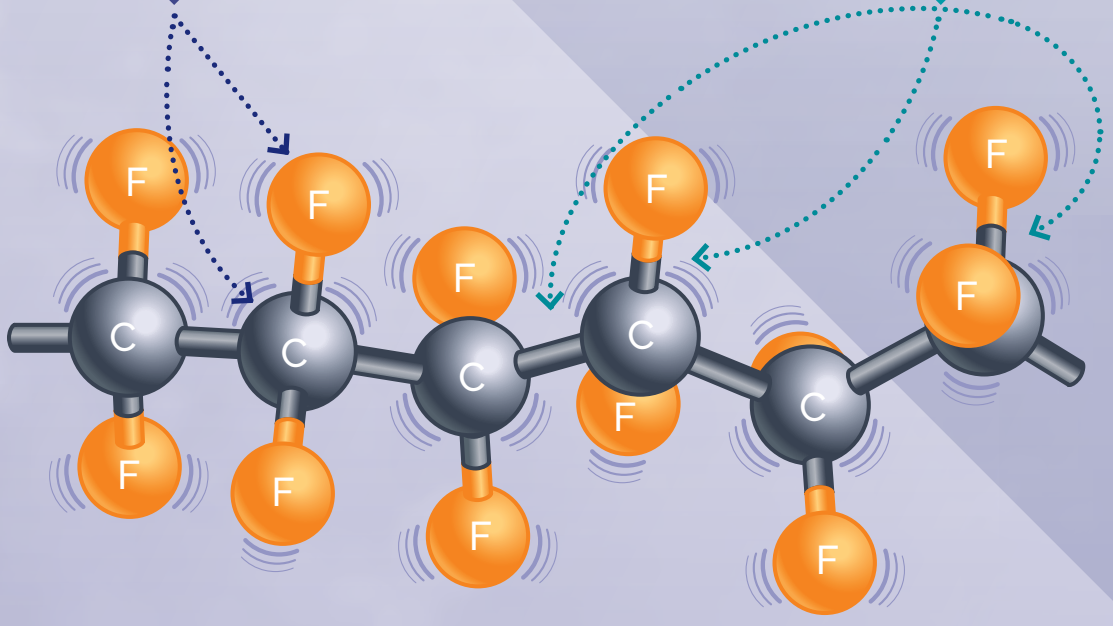
Target: Atoms – Determine elemental composition

EDS



Target: Bonds – Identify molecules and their bonding characteristics

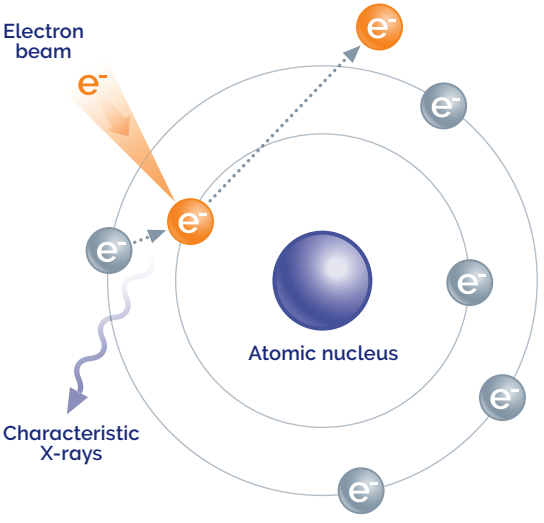
Raman



Teflon (Polytetrafluoroethylene, PTFE)

EDS Analysis

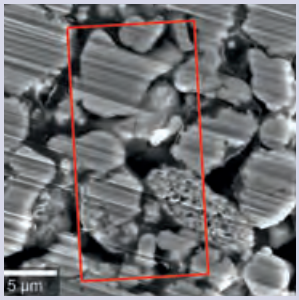
EDS (Energy Dispersive X-ray Spectroscopy) is a technique for elemental and compositional analysis based on the detection and analysis of X-rays produced by electron irradiation of a sample. Ionisation causes an inner-shell electron of constituent atoms to be ejected. This creates a vacancy in the electron orbital. An electron from an outer shell, with a higher energy level, transfers to the inner shell to stabilise it, and an X-ray is emitted during this process. This so-called characteristic X-ray has a specific energy value for each element. From such signals, it is possible to determine microstructure, composition and crystal structure.



The principle of EDS

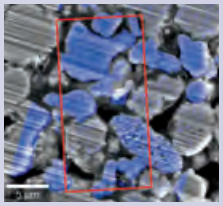
Applications: SEM, Raman & EDS imaging

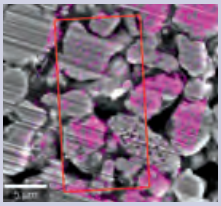
Battery materials

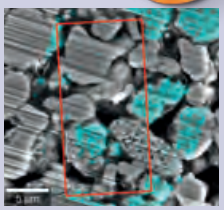


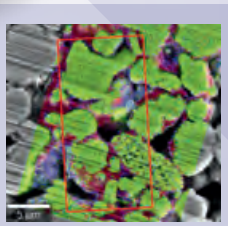
SEM

EDS

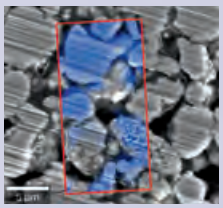

Co

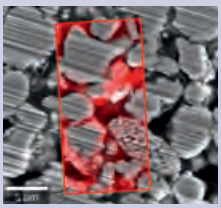

Mn

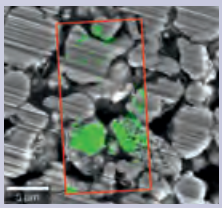

Ni

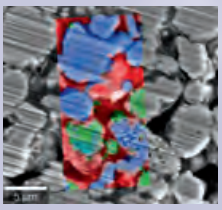

Metals & oxygen (green), carbon (red), fluorine (blue)

RISE


$LiCoO_2$


C (amorphous)

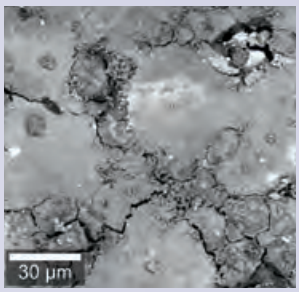

$LiNi_xCo_yMn_2O_2$


combined

Investigation of battery cathode materials. EDS (top row) reveals the distribution of the individual metallic elements. RISE delivers complementary information on microstructure and the distribution of chemical components along with the carbon matrix.

Sample courtesy: University of Southampton

Nutritional supplement tablet



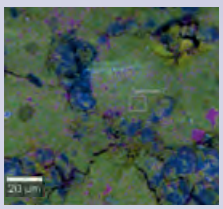
SEM

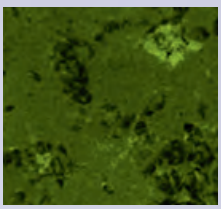
RISE


combined

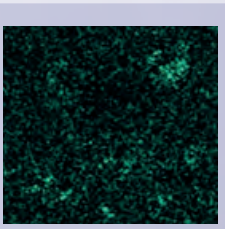
- Maltoheptaose
- 1-O-Hexadecyl-2-Palmitoyl-sn-Glycero-3-Phospho-(n-Palmitoyl)-Ethanolamide sodium salt
- Hydromagnesite
- Calcite

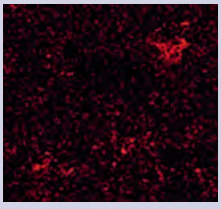
EDS

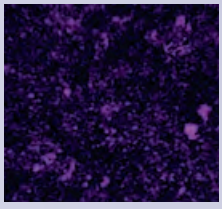

combined


Mg


C


K

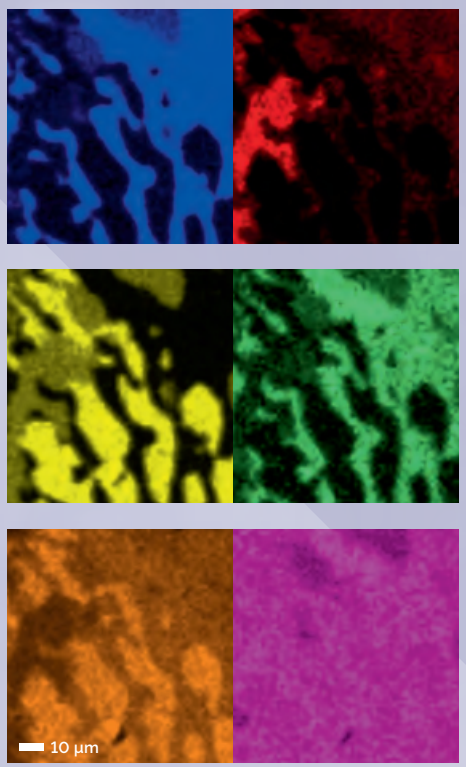

Ca


Si

Components of a nutritional supplement tablet. The RISE image visualises the distribution of the ingredients on the surface and the EDS data shows its contained elements.

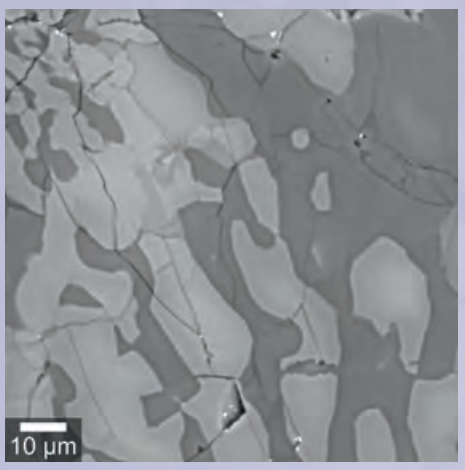
Geological sample

EDS



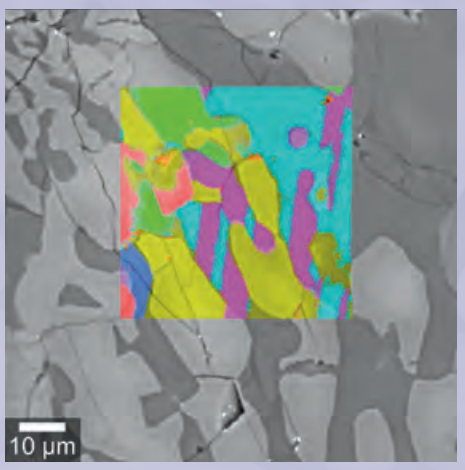
- Al
- Ca
- Mg
- Na
- O
- Si

SEM



Backscattered electron (BSE) image

RISE (Raman + SEM)



- Plagioclase in two different crystalline phases $(Ca,Na)[(Al,Si)AlSi_2]O_8$
- Diopside $CaMgSi_2O_6$
- Enstatite $Mg_2Si_2O_6$
- Pargasite $NaCa_2(Mg_4Al)(Si_6Al_2)O_{22}(OH)_2$
- Augite $(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$

Analysing a geological sample with EDS and RISE reveals the distribution of the elements and minerals along with the microstructure through SEM.

Oxford Instruments NanoAnalysis detectors used in electron microscopes for materials characterisation.

Unity: The world's first Backscattered Electron and X-ray (BEX) Imaging detector

RISE: Raman Imaging and Scanning Electron microscopes

WE TAKE CARE – WITec uses environmentally friendly printed materials. While this policy is only a small contribution to a healthy environment, we at WITec believe that focusing on details can effect positive change in the world.

Oxford Instruments NanoAnalysis

Halifax Road, High Wycombe Buckinghamshire
HP12 3SE, United Kingdom
Phone +44 (0) 1494 442255, Fax +44 (0) 1494 524129
https://nano.oxinst.com

WITec Headquarters

WITec Wissenschaftliche Instrumente und Technologie GmbH
Lise-Meitner-Str. 6, D-89081 Ulm, Germany
Phone +49 (0) 731 140 700, Fax +49 (0) 731 14070 200
info@witec.de, https://raman.oxinst.com

Explore the possibilities of RISE/EDS

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