



SCOPE

Forensic Chemistry



Instrumentation



- Scanning Electron Microscope with Energy Dispersive X-Ray Spectroscopy (EDS)
- Capable of elemental analysis

<https://ashrafkuwait.com/wp-content/uploads/2014/08/2934.png>

SEM Function

- Electron beam produced at top of SEM
- Beam directed down in a vacuum
- Electromagnetic fields and lenses focus beam
- Beam hits sample, electrons and X-rays ejected
- Detectors collect secondary electrons and X-rays, convert them into a signal
- Signal sent to monitor; final image produced

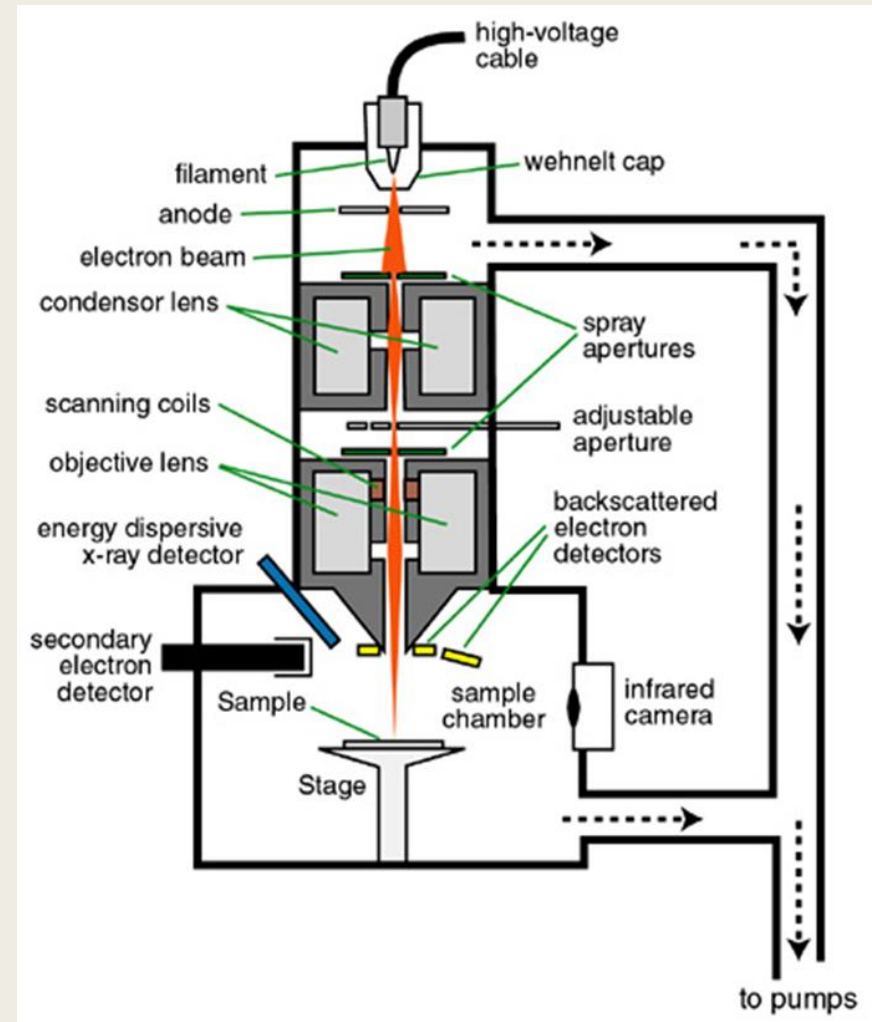
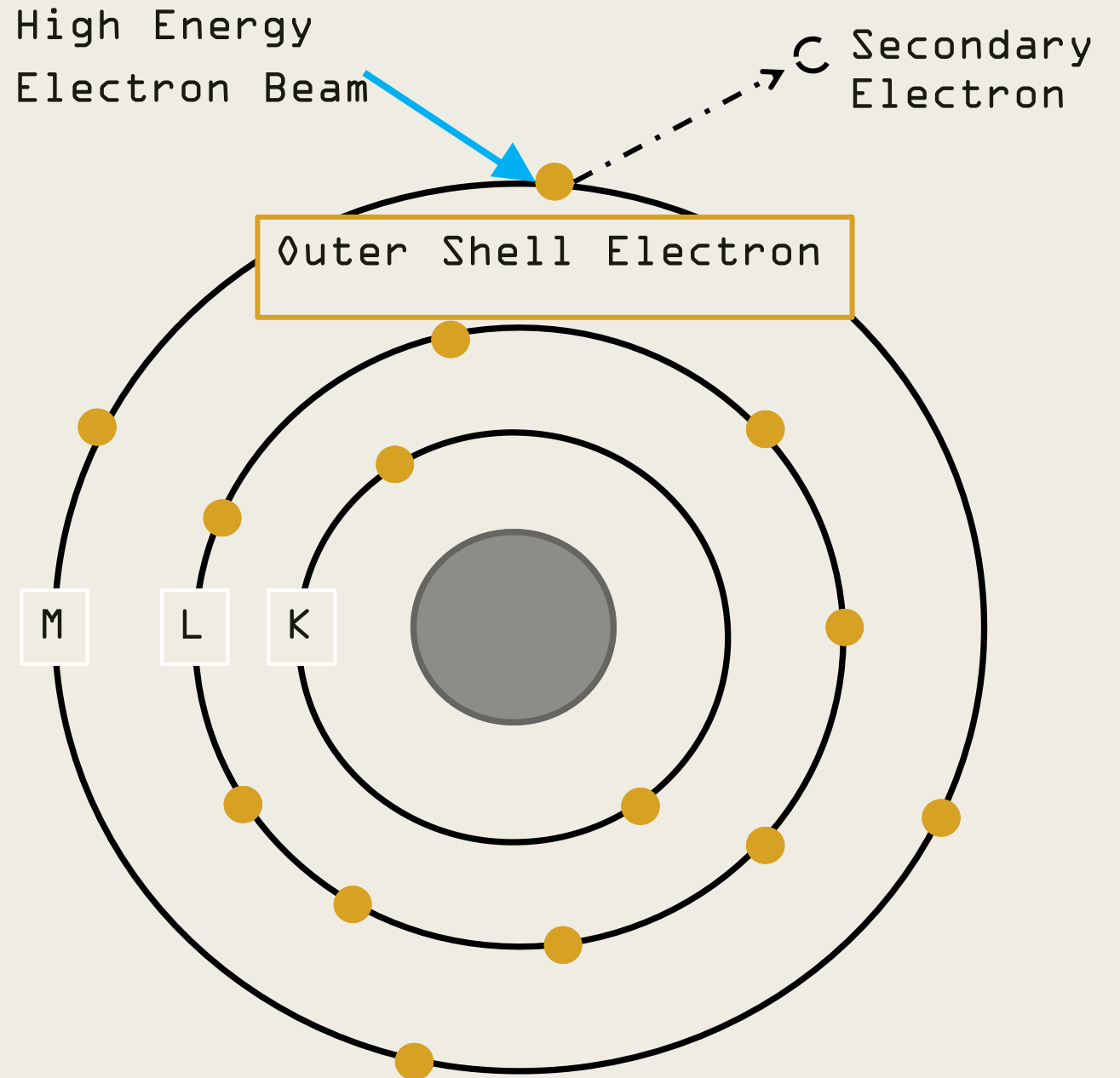
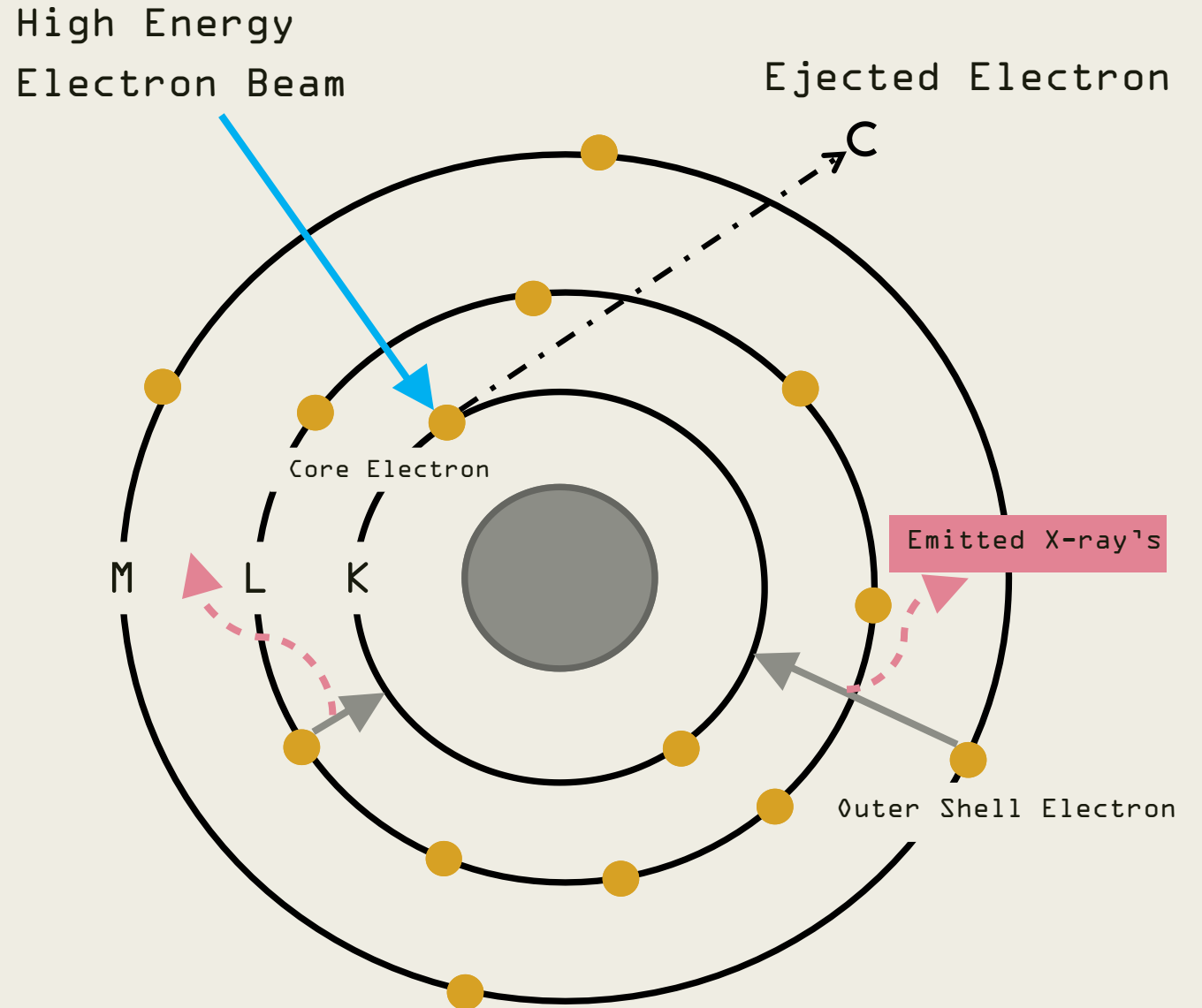


Image Generation



Element Detection

- Electron beam at high energy
- Beam ejects core electron, leaving a hole
- High energy electron drops into hole
- Energy is released

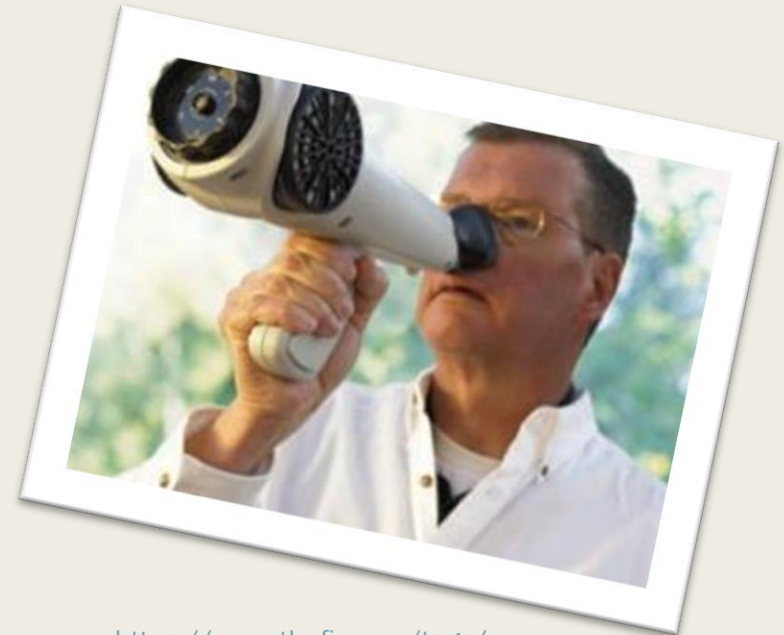


Background



<http://rebloggy.com/post/futurama-bender-fry-amy-leela-nibbler-planet-express-dr-zoidberg-it-is-real-prof/63212977164>

- Professor Farnsworth's home laboratory was broken into
- His new invention, the Smell-O-Scope was taken



<https://www.thefix.com/tags/smell-o-scope>

The Evidence



- White powdery substance found at the scene

<https://www.dermascope.com/resources/7983-zinc-oxide-historical-uses-and-modern-benefits>

The Suspects

B. Rodriguez

- Employee in charge of shipping and receiving
- Recently returned from Algeria where he picked up a shipment of valentinite for the Professor

Dr. Wernstrom

- Known rival of Prof. Farnsworth
- Suffers from severe eczema, always has medication on him

Scruffy, the janitor

- Also does construction jobs at the Professor's home
- Recently installed new cement walkway for the Professor

Image Collection

- Zoom in to the sample until it fills the screen
- Focus the sample to get a clear image

The screenshot displays the JEOL SEM software interface. At the top, the menu bar includes File (F), Edit (E), Function (O), Image Processing (I), Tools (T), Setup (S), Maintenance (M), and Help (H). Below the menu bar, there are several control panels. The 'Observation' panel shows 'Accel. Voltage' set to 2.00kV and 'Emission current' set to 0.0µA. The 'Focus' and 'Magnification' buttons are circled in red. The 'Stage Map' panel shows a grid with a yellow circle highlighting a specific area. The 'SEM Monitor' panel shows 'Vacuum' at 9.6E-5 Pa and 'Spec. Surface Offset' at 0.0 mm. The 'Recipe' panel shows a list of observation conditions. The bottom status bar displays 'X 25', '2.00kV', 'LEI', 'LM', 'WD 38.0mm', '10:24:57', and 'JEOL 5/21/2020'. The 'Stage Map' panel includes a table with columns for No., memo, X, Y, R, Z, and T.

No.	memo	X	Y	R	Z	T
P		0.000	0.000	0.0	8.0	0.0
Q		0.000	0.000	0.0	8.0	0.0
1	1	12.3...	-8.117	0.0	10.0	0.0
2	2	12.7...	1.467	0.0	10.0	0.0
3	3	12.8...	8.170	0.0	10.0	0.0
4	4	-0.570	-15....	0.0	10.0	0.0
5	5	-0.170	-7.191	0.0	10.0	0.0

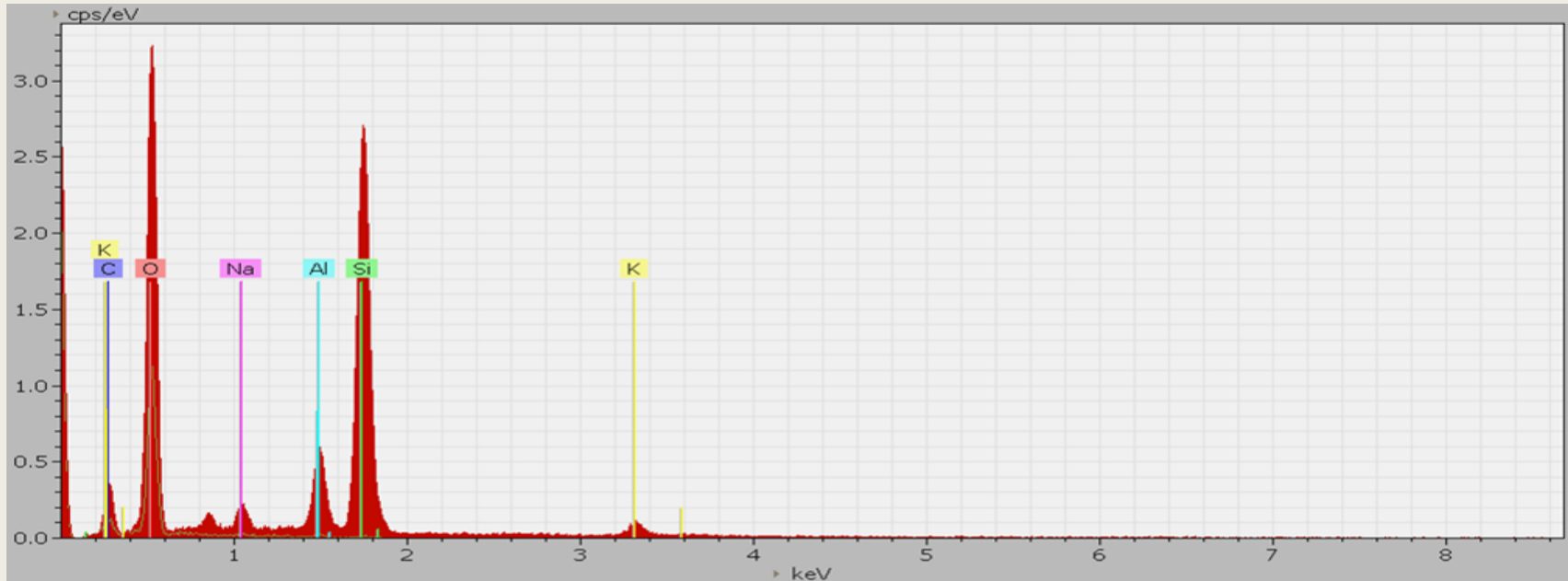
Bottom status bar: X 25, 2.00kV, LEI, LM, WD 38.0mm, 10:24:57, JEOL 5/21/2020

SEM Monitor: Vacuum 9.6E-5 Pa, Spec. Surface Offset 0.0 mm

Recipe: Standard, User, BEI observation of metals, BEI observation of MR heads, Biological, Cross-sectional(Nonconductive), Fine powders(about 1µm), Heavy metals, Light metals, Lower detector(High Mag), Lower detector(Low Mag), Semiconductors(Nonconductive), Super fine powders(less than 0.1µm), Cryo observation, Plastics(with coating)

Stage Map: X: 0.280, Y: -0.432, R: 1.0, Z: 38.0, T: 0.0

Data Collection



- X-rays are plotted based on energy level and intensity
- Software used to match peaks to elements
- Element quantity determined by peak area

Data Interpretation

	Series	unn. C [wt.%]	nor. C [wt.%]	Atom C [at.%]	Error (1 Sigma) [wt.%]
Oxygen	K series	58.80	50.73	61.26	7.86
Silicon	K series	24.55	21.18	14.57	1.08
Aluminium	K series	12.43	10.72	7.68	0.63
Carbon	K series	7.91	6.83	10.98	2.11
Iron	K series	5.25	4.53	1.57	0.28
Magnesium	K series	2.10	1.82	1.44	0.16
Potassium	K series	3.46	2.98	1.47	0.16
Sodium	K series	1.41	1.22	1.02	0.15
	Total	115.91	100.00	100.00	

- Record the percentages of each element found
- Calculate the chemical equation from your data

Solve the Crime!

Titanium
Dioxide
(TiO_2)

- Commonly used as a white pigment
- Added to the surface of cements, tiles and paints to give sterilizing and deodorizing properties
- Culprit is Scruffy



Solve the Crime!

Zinc
oxide
(ZnO)

- used as a skin protectant in sunscreen, diaper rash cream, and acne treatments
- also used to treat skin irritation caused by eczema
- Culprit is Dr. Wernstrom



https://villains.fandom.com/wiki/Professor_Ogden_Wernstrom

Solve the Crime!

Antimony
trioxide
(Sb_2O_3)

- The most important commercial compound of antimony
- found in negligible quantities in nature as valentinite, apart from the Constatine province of Algeria, where it is mined as an ore
- Culprit is B. Rodriguez



<https://www.imdb.com/title/tt0584448/>