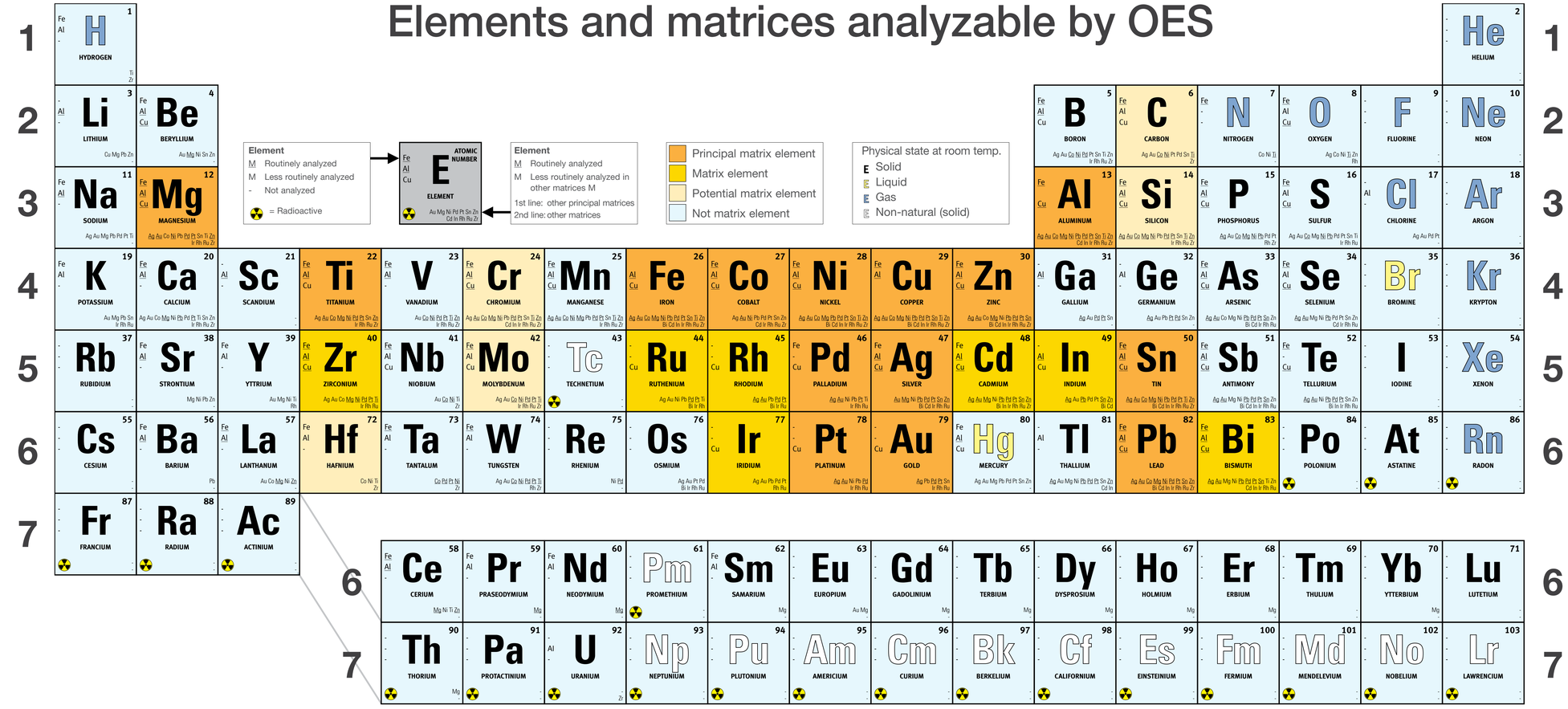
Spark optical emission spectrometry (OES) periodic chart

Elements and matrices analyzable by OES



The content of this table is indicative, may depend on instrument and is subject to change.
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Principles of spark optical emission spectroscopy

Spark optical emission spectrometry (OES) is a form of atomic emission spectrometry (AES). OES is simple and fast, and needs little maintenance and consumables.
It quantitatively analyzes most elements in solid metallic samples, from trace to percent levels. OES is therefore a preferred analysis technique in all the industries dealing with metals.

Thermo Scientific Spark Optical Emission Spectrometer

1. Sample stand and excitation spark source
2. Spectrometer console containing optics (with vacuum system on advanced instruments), control and acquisition electronics, argon distribution and filtering system
3. Computer and screen

Principles of optical emission analysis

OES analysis is based on the ablation of sample material by electrical sparks plasma. The ablated material is atomized and the atoms excited in the plasma. A de-excitation process is the emission of light. The emitted wavelengths are characteristic of each element and their intensity is proportional to the element's concentration in the sample.

The quantitative analysis sequence consists in the five following steps:

(1) PREPARATION → (2) EXCITATION & LIGHT EMISSION, (3) LIGHT SEPARATION, (4) LIGHT DETECTION & ACQUISITION → (5) DATA PROCESSING

Note: steps 3-5 can be considered as simultaneous (sequential only at the single spark time-scale)

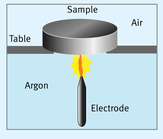
During both preparation and excitation steps, high energy single sparks are repeated at a high frequency between the metallic sample lying on the stand table and the electrode located below, inside the gas-filled stand.

A measurement lasts typically 10-30s, depending on the material analyzed. It is repeated several times to obtain average concentrations representative of the sample. The overall analysis duration is therefore typically 1-3 minutes.

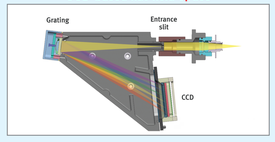
1. Preparation

Flush and pre-spark compose this step. The flush allows purging and cleaning the inside of the stand with analytical gas (usually argon). The pre-spark is a series of discharges that allows preparing the surface to analyze, essentially by cleaning and locally re-melting the sample for better homogeneity.

Excitation stand



CCD-based flat-field optics



2. Excitation and light emission

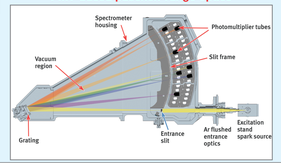
The excitation sparks perform several different operations:

- Generation of plasma between sample and electrode
- Ablation of material at the sample surface
- Atomization of the ablated material
- Excitation of outer electronic levels to higher energy levels

3. Light separation

The light emitted is directed towards the optical system. The main component of the system, the diffraction grating, separates the polychromatic light into its monochromatic constituents by dispersion over a certain wavelength range.

PMT-based paschen-runge optics



4. Light detection and acquisition

The photons of the wavelengths of interest are usually detected with PMT's (photo multiplier tubes) and transformed into electrical signals. Alternatively the full spectrum or part of it may be collected with CCD detectors.

5. Data processing

The intensities from PMT's or CCD's are converted by the analytical software into concentrations thanks to calibrations established with reference samples. Spectral interferences and matrix effects are also corrected by the analytical software. Routine analysis is easy and fast. Data can be printed, stored and transferred.

Prerequisites for analysis with a spark OES spectrometer

- Solid, conductive and homogeneous sample
- Clean and flat sample surface
- Availability of certified reference materials (CRM) or reference materials (RM) for calibration
- Availability of setting-up samples (SUS) for recalibration (to maintain accuracy)

Sample preparation

The preferred sample preparation techniques are:

Stone grinding: for cast irons

Paper grinding: for most steels, nickel, cobalt and titanium alloys.

Milling machine or lathe: for soft materials, non-ferrous metals and alloys and for all materials where contamination must be avoided (pure metals, fine precious metals, micro-alloyed steels, etc.)

Find out more at **thermofisher.com/oes**

PO41224-EN 01/24