HITACHI
Inspire the Next

THE AUTOMOTIVE TRENDS CHANGING PMI ANALYSIS AND HOW YOU CAN BE READY

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AGENDA

1. Rise of lighter-weight metals
2. 100% PMI
3. Alloy analyzer technology
4. Instrument toolbox – right tool for every purpose
5. Questions and answers

RISE OF LIGHTER-WEIGHT METALS

REGULATIONS

The driving force behind change globally:

- Euro 6 and China 6
- Light vehicle testing procedure
- New automotive quality system standard
- ELV Directives

THE NEED TO SHED WEIGHT

- Reducing weight is the easiest way to influence carbon emissions.
- Aluminium and also magnesium alloys are replacing traditional materials such as steels in automotive manufacturing
- New alloys are more and more complex and require rigid quality control processes throughout the manufacturing chain.

ALUMINIUM

Advantages:

- Light weight
- Corrosion resistance
- Workability
- Availability
- Add elements such as Zinc, Copper and Lithium to increase strength and reduce weight

Disadvantages:

- Cannot be used in all parts due to strength needed
- Expensive
- Workability and weldability more challenging than when using traditional materials

MAGNESIUM

Advantages:

- Even lighter than aluminium
- Highest strength to weight ratio of all structural metals
- Available in abundance and easily recyclable

Disadvantages:

- Brittle
- Doesn’t have the creep resistance of aluminium
- Corrosion resistance is worse compared to aluminium alloys

STEEL MAKING A COME BACK

Advantages:

- Better strength
- Lower cost
- Weight gap to Al reduced
- Workability

Disadvantages:

- Heavy compared to Al and Mg alloys

100% PMI

IMPORTANCE OF QUALITY CONTROL

Why is quality control so important?

- Wrong alloy or component from the supplier
- Mixed up or forged certificate
- Material mix-ups in the warehouse
- Certificate or stamp lost

What would be the cost to you and your business if a wrong material would be used? – Trust but verify!

WHAT IS 100% PMI?

- An increasing trend in the fabrication and manufacturing industry where all the incoming material is checked to verify that the right materials are being used throughout the manufacturing process.
- Automotive industry is one of the first adopters of more rigorous incoming inspection of goods and 100% PMI.
- The checks can also be performed at later stages throughout the process.

PMI IN AUTOMOTIVE SUPPLY CHAIN

Incoming inspection

- Ensuring quality of raw material
- Verifying that material matches the certificate

Factory floor QC

- Avoiding mix-ups
- Checking the material before machining

Final inspection

- Checking the finished product before sending it out to the customer

These steps not only ensure the quality of the end product but also strengthens the company’s brand as a trusted supplier.

CHECKLIST FOR SUCCESSFUL 100% PMI

- 100% PMI means significant increase in the number of samples measured.
- In some cases, up to hundreds or even thousands of samples need to be measured every day.
- To keep the process efficient, several requirements are set for the analysers:
    1. Fast and accurate analysis and identification
    2. Powerful tools to manage the amount of data created
    3. Robust and reliable design
    4. Responsive service for minimum downtime
    5. Low cost of ownership

ALLOY ANALYZER TECHNOLOGY OVERVIEW

LIBS
(LASER INDUCED BREAKDOWN SPECTROSCOPY)

Alloy identification in one second. **No X-rays** means no hassle, and no special licenses or training needed.

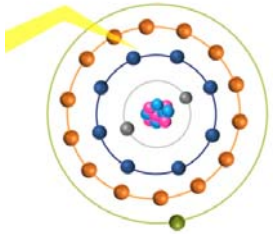
XRF
(X-RAY FLUORESCENCE)

Fast, accurate and **non-destructive testing** of virtually any material, including metal alloys.

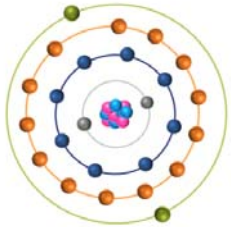
OES
(OPTICAL EMISSION SPECTROSCOPY)

Uncompromised performance, right down to trace element levels, including boron, carbon, nitrogen and other elements.

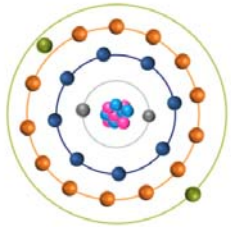
HOW DOES XRF WORK?



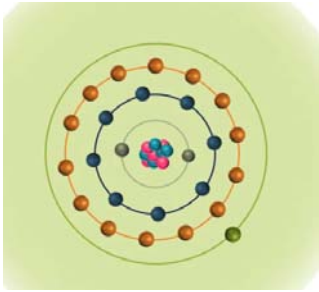
Excitation by
X-Ray energy



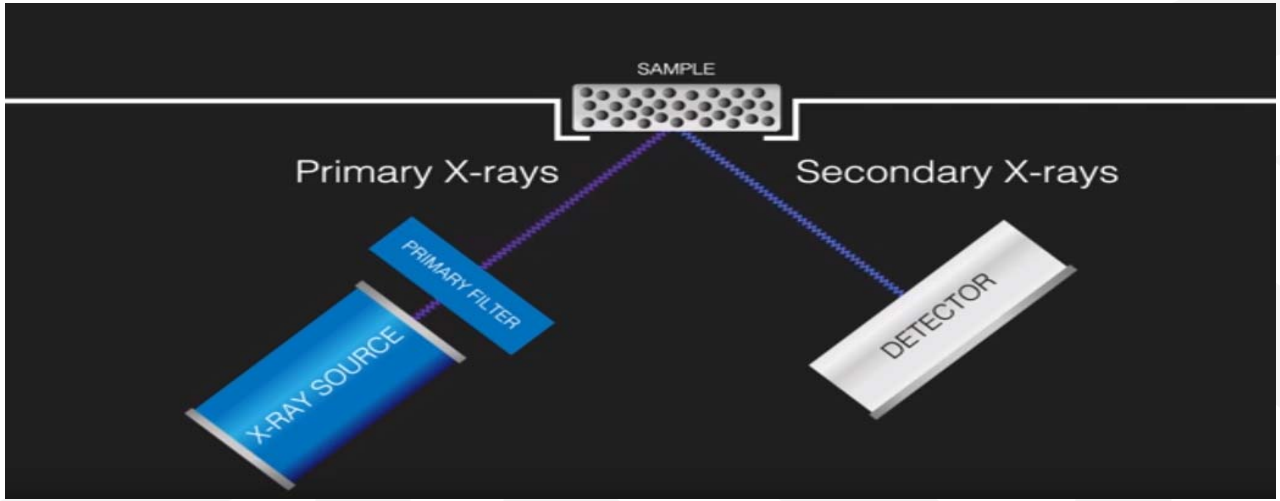
Electron kick out



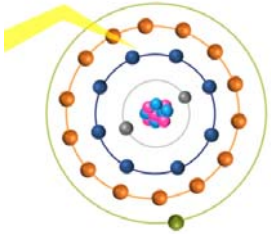
Electron drop down to
establish stability of the atom



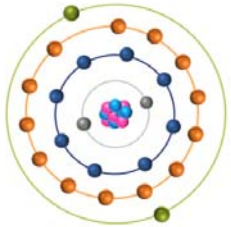
This results in released
defined X-Ray energy



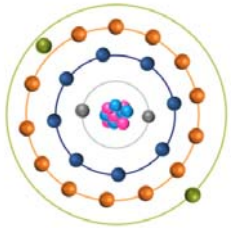
HOW DOES LIBS WORK?



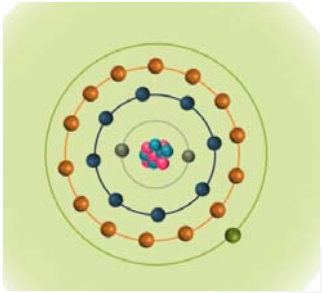
Excitation by laser energy



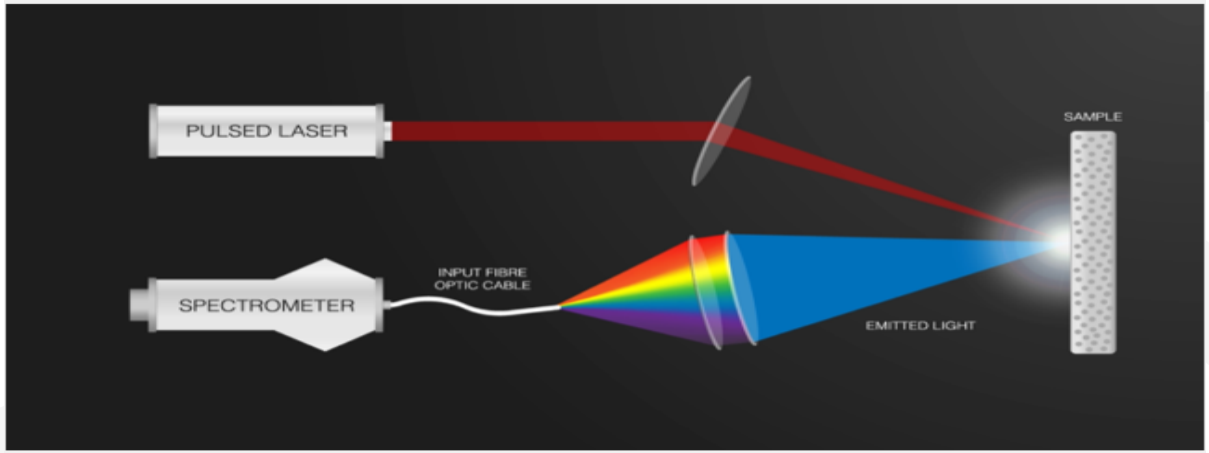
Electron kick out



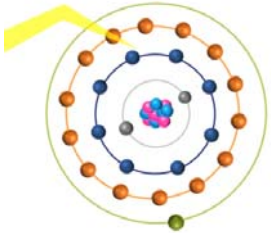
Electron drop down to establish stability of the atom



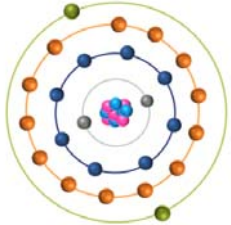
This results in released defined light energy



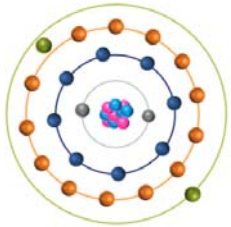
HOW DOES OES WORK?



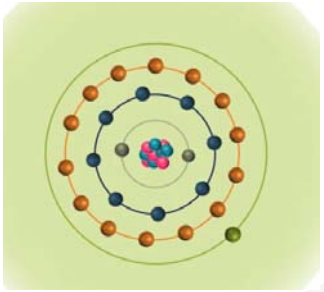
Excitation by spark or arc energy



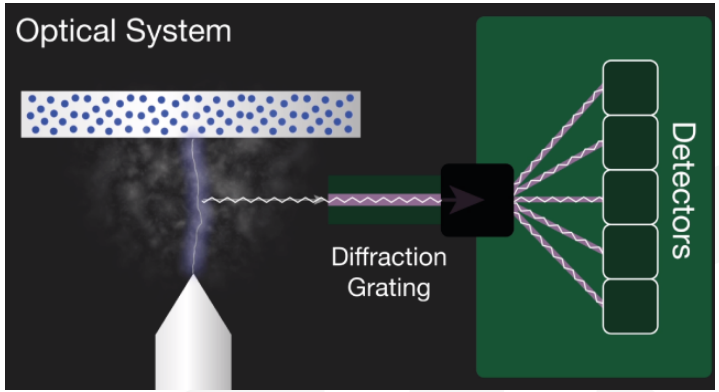
Electron kick out

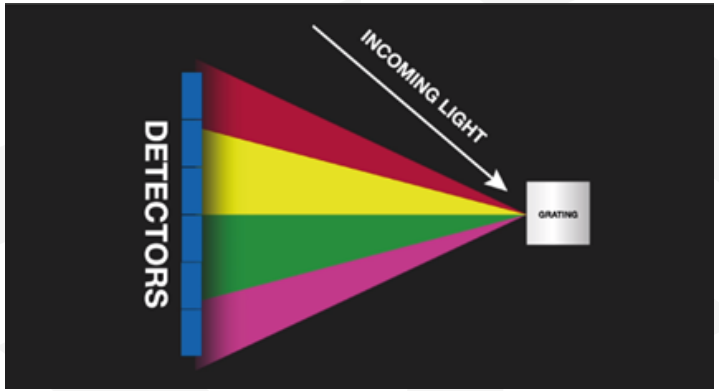


Electron drop down to establish stability of the atom



This results in released defined light energy





NON-DESTRUCTIVE TESTING

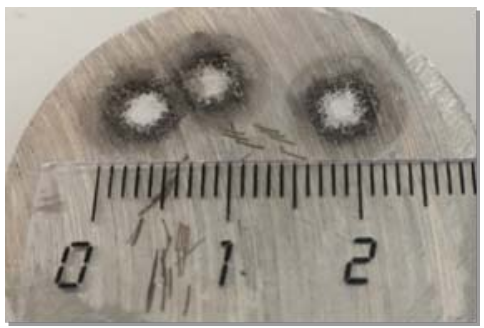
- Some applications require non-destructive testing (NDT)
- The effect to the sample depends on the technology being used:

  XRF: the only totally non-destructive method

  LIBS: a small burn mark (scratch) is left on the surface

  OES: clear burn mark is left on the sample surface
- Typically the incoming inspection of the raw material can be done with any technology and there is no NDT requirement.
- End products can have a strict NDT requirement.

LIBS burn mark



OES burn mark

INSTRUMENT TOOLBOX – RIGHT TOOL FOR EVERY PURPOSE

HANDHELD XRF - STRENGTHS

- Fast, accurate and precise tool for PMI applications.
- Comprehensive chemistry of up to 35 elements on a single measurement.
- Analysis from ppm-level to 100%.
- Measurement times typically 3-10 seconds depending on the alloy type.
- Robust, designed specifically for harsh conditions.
- Least sensitive of the three techniques to sample surface conditions.

HANDHELD XRF - LIMITATIONS

- Detection limits higher than OES, depending on element levels below 100-1000 ppm can be challenging.
- Slower than HHLIBS especially on light elements (Mg, Al, Si) and Aluminium alloys.
- Can’t analyze Carbon, Nitrogen (steel and iron), Lithium (Al-alloys) or Beryllium (Cu-alloys), or low levels of Phosphorus and Sulfur (Carbon Steel).
- X-ray emitting devices are often regulated and require safety training and licensing.

HANDHELD LIBS - STRENGTHS

- Ultra fast sorter – 1 second analysis regardless of the alloy type, including Al alloys.
- No X-rays.
- Very simple to use.
- Easy user maintenance, no protective windows to replace.
- Samples can be measured in hand.

HANDHELD LIBS - LIMITATIONS

- Excellent sorting tool but not as analytically accurate as HHXRF and OES.
- Detection limits higher than HHXRF and OES.
- Can’t analyze Nitrogen (steel and iron) or Phosphorus and Sulfur (steel and iron).
- Leaves a small scratch on sample.
- Some sample preparation required, can’t penetrate well through layers of oxidation or coatings.

OES - STRENGTHS

- High accuracy analysis of elements down to ppm level.
- Ultimate performance on all alloying and trace elements.
- Able to analyze even low carbon concentrations (L -grade separation).
- Able to determine Duplex steel grades via Nitrogen analysis.
- Able to measure Boron in steels down to ppm levels.
- Highest element range flexibility and versatility.

OES - LIMITATIONS

- Requires Argon in spark applications.
- Requires sample preparation (clean, ground surface is necessary).
- Leaves visible burn mark on sample.
- Calibration is not automatic (Multi-Matrix).
- Total measurement time longer than handheld XRF and LIBS.

ANALYTICAL PERFORMANCE COMPARISON – XRF, LIBS AND OES

I want to measure…	LIBS	XRF	OES
Rapid identification of stainless steels	●●●	●●●	●●
Sulphur and phosphorous in stainless steels	–	●●	●●●
Trace elements in stainless steels	–	●●	●●●
Carbon in stainless steels (L-grades, < 0.03% carbon)	–	–	●●●
Boron in steels	–	–	●●●
Low alloy steels	●●	●●	●●●
Aluminium alloys	●●●	●●	●●●
Lithium and Boron in Al alloys	●	–	●●●

●●● **Best available instrument**
●● **Good performance, some shortcomings**
● **Screening and ID.Better instrument is available and recommended for accurate analysis.**
– **Not possible with the instrument**

WHAT ARE YOUR REQUIREMENTS?

THERE IS NO ONE-SIZE-FITS-ALL INSTRUMENT

There's a need to determine how the analyzer will be used:

- What is the purpose of the testing?
  - Grade verification
  - Full chemical analysis
- What elements are important? – Critical to choose the right instrument.
  - C, N, B, P, S, Al, Si, Mg, Be, Li
- At what levels are these elements present?
  - Trace
  - Alloying Element
- What form and size are the samples?
  - Small, large, flat, smooth, uneven surface…
- Where does the analysis need to take place?
  - Indoors, outdoors, clean/dirty environment…
- Is a small burn mark on the sample surface allowed? (NDT requirement)

HITACHI HIGH-TECH'S TOOLBOX

X-MET8000 SERIES

XRF provides fast and accurate analysis of all common alloys. Low detection limits and because of **totally non-destructive technology,** it can also be used for finished goods.

VULCAN SERIES

LIBS is the **fastest tool for alloy and metal sorting** with just one second measurement time. Ideal for checking incoming material and performing checks in the fabrication process.

MOBILE AND STATIONARY OES

OES provides **the highest level of accuracy** and it's the only technique that can provide high accuracy analysis of Carbon, Boron and Nitrogen in steels.

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THANK YOU FOR YOUR ATTENTION

Any questions?

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POLLING QUESTION