X-Ray Diffraction for Phase Identification

Background

X-ray diffraction is one of the most powerful tools for identifying unknown crystalline phases. By comparing the positions and intensities of the diffraction peaks against a library of known crystalline materials, the target material can be identified. In addition, multiple phases in a sample can be identified and quantified. Even if one of the phases is amorphous, x-ray diffraction can determine the relative amount of each phase.

Applications

Crystal structure	Quantitative multiphase analysis
Corrosion products	Amorphous/crystalline contents
Forensic analysis	Quality control
Intermetallics and contaminants	Phase transformations

Example 1

Coatings applied by flame spraying often undergo deterioration due to oxidation and decomposition. In the application shown in Figure 1, a coating of tungsten carbide (WC) containing 8 weight percent Co was flame sprayed onto a steel plate. As shown by the x-ray diffraction pattern, the WC had decomposed into W_2C and W. In addition, the tungsten and cobalt experienced extensive oxidation as evidenced by the appearance of WO_3, $WO_{2.92}$ and CoO. Identification of these phases gave important insight into the conditions within the flame during deposition.

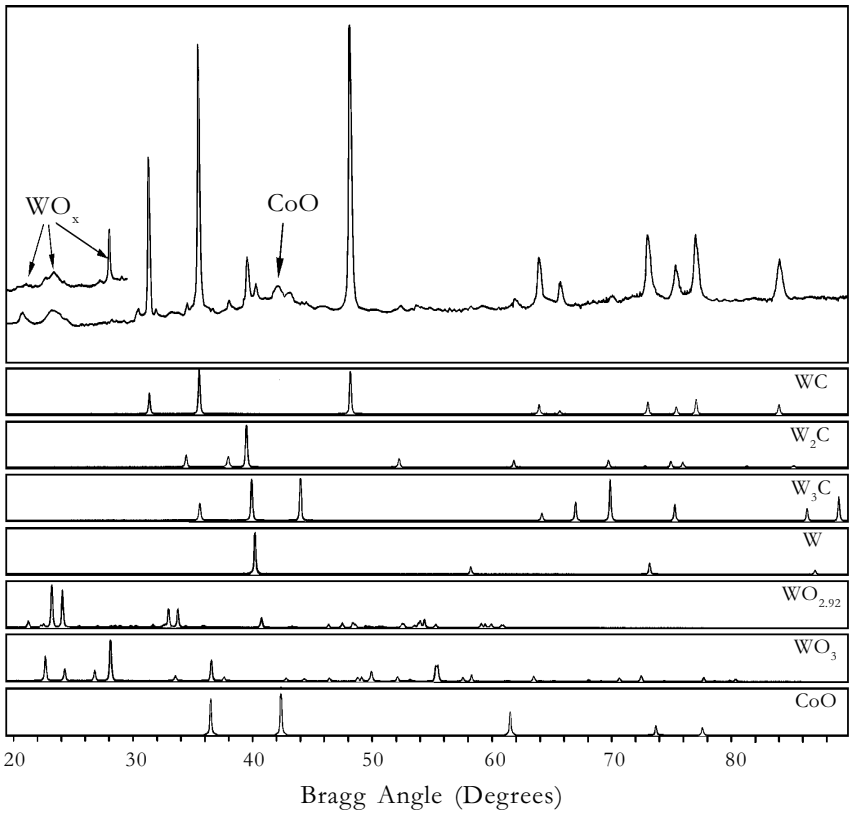

Figure 1 X-ray diffraction pattern of WC/Co coating

Example 2

Corrosion products are sometimes difficult to identify since their patterns are complex and several phases appear together. In this situation, the identification of the material is facilitated by adding an internal standard, which permits a correction for systematic errors. By doing this, the precision of the diffraction pattern improves and the identification process becomes significantly easier. In the diffraction pattern shown in Figure 2, silicon (Si) has been added to a corrosion product taken from a water cooling unit. After correcting the pattern for the unavoidable displacement errors, the powder was easily identified as a mixture of $NaHCO_3$ and $CaSO_4$ with the aid of the Powder Diffraction File.

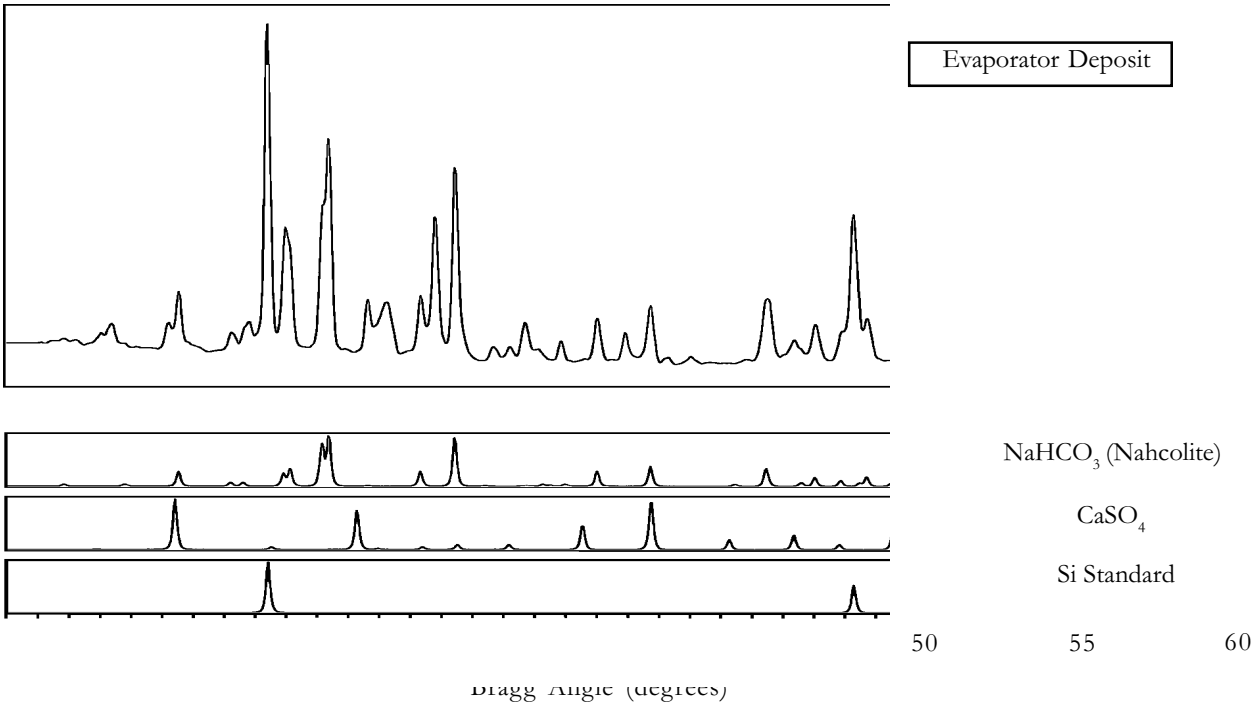

Figure 2 X-ray diffraction pattern of corrosion product mixed with Si internal standard

Our Pledge

H & M Analytical Services has over 30 years experience in X-ray diffraction. With our state-of-the-art equipment, we will strive to apply our experience and knowledge to solve your most challenging problems. In most cases, we will provide turnaround of 24 hours on phase identification analyses at no additional cost. Sample preparation services are also available. Most samples can be run on a flat fee basis. For details, please contact us.

Other Services We Provide

We provide a wide range of X-ray diffraction services, including:

- residual stress analysis
- precision lattice parameter
- texture analysis
- Rietveld analysis
- particle size determination
- high temperature XRD
- analysis of modulated films
- misfit strains
- fiber analysis
- crystal orientation
- grazing incidence angle
- retained austenite analysis

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