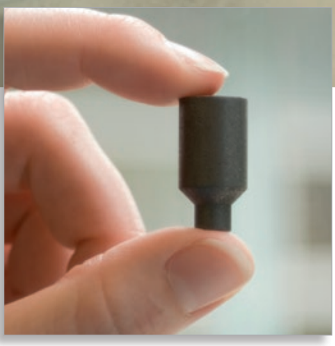

Elemental Analysis

- inorganic materials
- oxygen, nitrogen, hydrogen, carbon, sulphur
- fast
- high accuracy
- quantitative

In many applications, e.g., the strength of steel or the light output of LED's, it is important to use raw materials with the right composition. Variation in amounts of O, N, H, C and S can have substantial influence on the properties of the product. Using an elemental analyser, these elements can be quantitatively determined in solid materials and liquids.

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Principle

Oxygen, hydrogen and nitrogen analysis

A graphite crucible (see small front page photo) is placed between two electrodes. High current passes through this crucible generating heat, up to temperatures of 3100 °C. After an outgassing procedure the sample is dropped into the crucible from a helium purged loading head. The oxygen released from the sample combines with the carbon of the crucible to form carbon monoxide (CO) and carbon dioxide (CO_2) which can be detected by Infra Red detectors. The generated gasses pass through a heated copper oxide column for the oxidation of CO to CO_2 and H_2 to H_2O. Infra Red detection is also used for the detection of those gasses. After trapping CO_2 and H_2O by scrubbers, the remaining gasses flow through a thermal conductivity cell used to measure nitrogen. Weakly and strongly bonded oxygen can be detected separately by optimising temperature steps, which makes it possible to distinguish surface oxides from bulk oxides.

Carbon and sulphur analysis

A sample mixed with accelerator material is placed into a ceramic crucible (see large front page photo). The system is closed and purged with oxygen. The sample and the accelerator material couple with the high frequency field of the furnace. The pure oxygen atmosphere and the heat induce the combustion of the sample where all elements are oxidized. Carbon from the sample reacts with oxygen to CO and CO_2. Sulphur also binds with oxygen to form sulphur dioxide (SO_2). The gasses pass through an Infra Red detector for detection.

Applications

- O, N, H, C, S in steel, alloys, nitrides and oxides
- O, N, C, S in carbon black, graphite & calcined coke
- O, N, H in DGA, tungsten and molybdenum
- O, N, H in deposits
- O, N, H, C in magnetic material
- S in battery paste
- S in $BaCO_3$ / $BaTiO_3$
- C in thin layers FeC
- C in filter sediments
- C in tungsten carbide powder

A typical application

Saving energy is a hot topic these days. Therefore, many light bulbs are replaced by Light Emitting Diodes (LED's). The colour of the LED's is determined by the phosphor or luminophore used. Stimulating a white phosphor using a blue-emitting LED will result in "white light". When small amounts of additives are mixed to the phosphor, a range of different "whites" can be created. The performance of these mixtures is very critical towards the composition. During the production of phosphors, the conditions in the heating step are very important. Small differences in O and or N amounts can result in rejection of a batch because of the wrong colour output. Using the elemental analyser, we can quantify (deviations in) O and N content with great accuracy.

Characteristics

Sample type
- solid
- liquid
- thin layers
- inorganic, partly organic

Quantitative
- yes

Accuracy
- 1-3% (relative)

Precision
- 1-3% (relative)

Detection limit
- 0.05 wt.ppm (O,N)
- 0.1 wt.ppm (H)
- 1 wt.ppm (C,S)

Measuring range
- wt.ppm – wt.%

Destructive
- yes

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