

Determination of hydrogen in steels with glow discharge spectroscopy (GD-OES) – limitations and possibilities

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Hydrogen can cause severe problems concerning the mechanical properties of steels. Detection and determination of low hydrogen contents in steels is therefore of great importance in the steel industry.

Various techniques exist to analyse hydrogen in steels. The most common technique for routine determination of hydrogen is hot extraction, releasing all hydrogen in gaseous form from a heated sample.

In order to be able to determine hydrogen with a good spatial resolution, GD-OES is a method with considerable potential. The analysis of the hydrogen distribution in coated materials can give useful information about the origin of hydrogen in steel products.

Some problems occur while introducing GD-OES as a technique for measuring hydrogen in steels. Accurate determination and depth profiling of hydrogen is difficult, above all due to the lack of suitable reference materials. Beside this, the influence of hydrogen on the spectra of other matrix elements – which varies with plasma parameters voltage and current – is of great importance for routine depth profile analysis. A reasonable hydrogen correction is an important tool in software quantification algorithms.

In addition, the diffusion of hydrogen during sputtering is not negligible. However, results of measurements on various bulk titanium reference materials show good correlation of the certified hydrogen content and the detected signal.

In other materials, the diffusion of hydrogen during sputtering plays an even more important role. Materials with similar matrix composition and total hydrogen content show different hydrogen signals, dependant on the diffusible hydrogen content. Qualitative comparison of the diffusible and total hydrogen content with hot extraction supports the assumption of a strong diffusion-dependant sputtering in GD-OES.

Even though those problems occur, GD-OES shows a very high sensitivity for hydrogen. A detection limit in the few ppm range can be achieved.

New systematic investigations will be presented, including problems and possibilities of using GD-OES as a standard technique for measuring hydrogen in steels.