Hydrogen in metals

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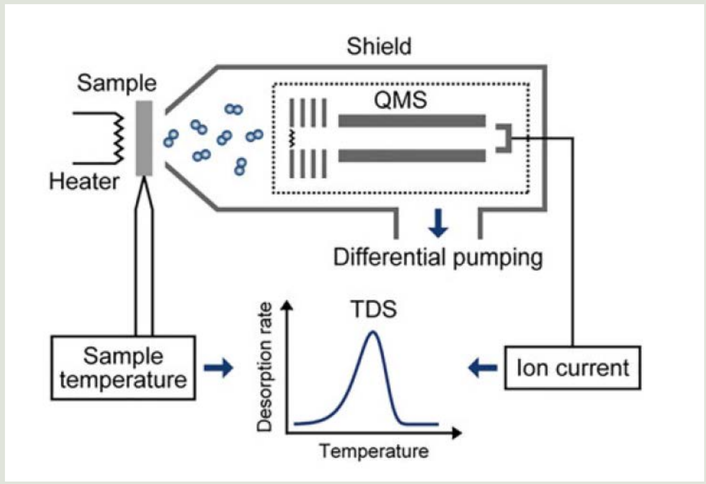
Abstract:

The objective of this chapter is to analyse interaction between hydrogen and metals. Different techniques that are able to give important information about lattice deffects that trap hydrogen were discussed. Most attention was given to the hydrogen desorption kinetics. Metal-hydrogen systems are very interesting because of their application in construction of energy storage devices.

Key words: hydrogen in metals, hydrogen storage



Introduction:

Metal hydride are very attractive for many future application such as hydrogen storage for a multitude of purposes, hydrogen compression and purification, thermal storage…

Storage of hydrogen (energy carrier for future transport) is one of the key challenges in developing hydrogen economy.

Studying interaction of hydrogen with materials defects and behavior of hydrogen within the crystal lattice is of great importance.

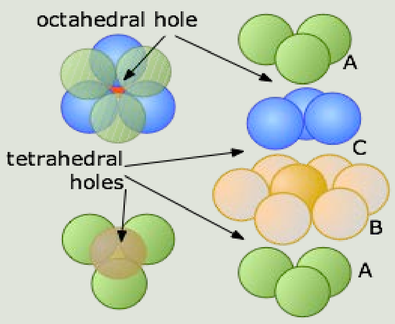
Titanium attracts wide interest for being a promising hydrogen store material .

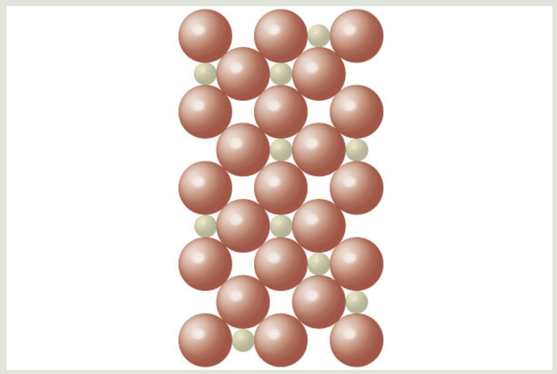
Titanium hydride TiHx is used for hydrogen storage due to its high capacity for hydrogen isotopes.

Hydrogen is trapped at specific places in the metal. Each place is characterized with specific binding energy which is needed to give to the material for hydrogen to be released from the trapping place.

Characterization techniques:

- Thermal desorption spectroscopy
- Raman spectroscopy





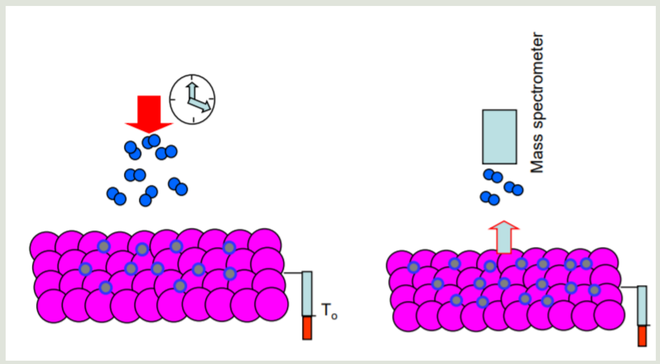
Hydrogen tends to occupy tetrahedral interstitial sites (normal interstitial lattices sites).

Commercially pure titanium is very resistance to hydrogen embrittlement but it becomes susceptible for hydrogen embrittlement in the presence of defects.

➢ THERMAL DESORPTION SPECTROSCOPY

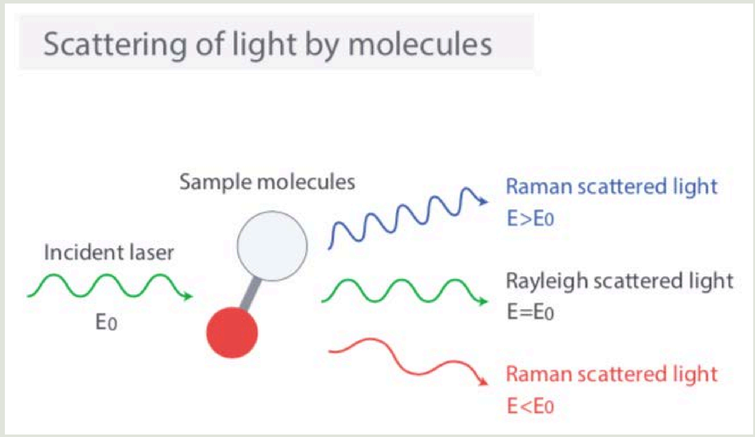
The thermal desorption spectrometry technique can be used to determine the trapping characteristics of different trap sites in metals.

-surface characterization techniques to evaluate hydrogen presence in metals.



When metal sample is heated in a vacuum, gas is desorbed from the surface. The rate of the gas evolution is changed with temperature. The partial pressures of atoms and molecules evolving from the sample are measure by mass spectrometry.

➢ RAMAN SPECTROSCOPY



- Raman spectroscopy is both qualitative and quantitative
- Non-destructive chemical analzysis technique which provides detailed information about chemical structure
- interaction of light with the chemical bonds within a material

- Raman spectrometry is used to characterized materials composition
- Identification of unknown materials
- Raman spectra contain peaks representing different molecules

CONCLUSION

The interaction between hydrogen and metals plays an important role in many engineering and scientific fields. Metal hydride are very attractive for many future application. Storage of hydrogen is one of the key challenges in developing hydrogen economy. The knowledge of fundamental properties of hydrogen in metals such as diffusivity, solubility and trapping at defects is very important. Experimental techniques such as Raman spectroscopy and thermal desorption spectroscopy (TDS) are used to study deuterons implanted into metals.

Thermal desorption spectroscopy is a method for studying detrapping and diffusion behaviour of hydrogen in metals by measuring the desorption rate of desorbing gas from the surfaces as a function of temperature. When hydrogen charged into metals it is trapped at various lattice defects. Raman spectroscopy provides chemical and structure information.

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