Tribological solutions to hydrogen-induced failures in steels

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This talk will give an introduction to tribology and the relationship with the efforts here at I^{2}CNER to prevent hydrogen related failures. A brief mention will be made regarding the current state of research in the field achieved here at I^{2}CNER, together with our available experimental/theoretical approaches. Finally, we would like to open a discussion about further progress in this area with the help of suggestions or possible collaborations from other researchers at I^{2}CNER.

Tribology is the science of interacting surfaces in relative motion and is a relatively new field compared to other engineering disciplines. The objective of tribology is to reduce friction and wear with the use of lubrication. Less wear leads to a longer lifetime for components, while less friction leads to the reduction of the forces applied.

In order to reduce friction and wear, most tribological systems use a lubricant film to prevent the contact between surfaces. Lubricants are usually complex mixtures containing a large number of additives performing different functions. Some additives interact with the surface and reduce friction and wear by forming tribofilms. These additives are particularly reactive towards the fresh catalytic surfaces generated during rubbing.

With the continuous increase in bearing steel strength, a new type of failure was observed in rolling elements related to the presence of atomic hydrogen in the material. Hydrogen is a small atom that permeates through the superficial layers of steel and uses its reducing character to modify the structure of the substrate. This can lead to unwanted changes of the material properties and can ultimately affect the reliability of components.

The talk will also describe the feasibility of using lubricant additives to reduce the permeation of hydrogen into bearing steel and subsequent hydrogen embrittlement. This is due to their ability to generate a protective tribofilm on the metal surfaces, which acts as a barrier against the permeation of hydrogen. This can reduce the negative effect of hydrogen in steel and paves the way for a clean, efficient hydrogen-based economy in the future, as described by the objectives of I^{2}CNER.