DE LA RECHERCHE À L'INDUSTRIE

Séminaire

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Salle de réunion du SRMP – Bâtiment 520 - Pièce 109

What can one learn about Fe-Cr alloys with Mössbauer Spectroscopy ?

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Fe-Cr alloys can be regarded as exceptional among various binary alloys of iron both for scientific and technological reasons. Concerning the former, they can be regarded as model alloys for studying various structural and physical properies using both experimental and theoretical tools. For a long time Fe-Cr alloys were regarded as one of a few examples of an alloy in which the constituting elements form a solid solution for any concentration and within the same viz. bcc structure. In fact, the bcc structure has turned out to be thermodynamically unstable, and the actual phase diagram is much more complex than initially regarded: depending on the composition and temperature of annealing, a σ-phase can precipitate or a phase decomposition into Fe-rich (α) and Cr-rich (α') phases leading to a miscibility gap (MG) can occur. Even more fascinating are magnetic properties of the Fe-Cr alloys, which, depending on the composition and temperature, show ferromagnetism, antiferromagnetism, pure spin-glass or re-entrant spin-glass behaviour. Regarding the technological aspect, Fe-Cr alloys are the basic ingredient of various grades of stainless steels (SS) that are used as construction materials in diverse branches of industry like petrochemistry (e.g. oil-refineries), power industry (e. g. nuclear power plants), transport (e. g. aircrafts). Due to the their excellent properties e. g. resistance to a high-temperature corrosion, SS steels are used for manufactoring devices that work at service at elevated temperatures. At these temperatures they are, however, not stable and either decompose into α and α' phases causeing thereby the so-called *475^{o}C embrittlement* or transform into the σ-phase which is also derimental.

The Mössbauer spectroscopy has proved to be suitable technique to quantitatively investigate practically all of the above-mentioned properties of the Fe-Cr alloys. In particular, the following issues will be addressed in this seminar:

- Fe-site spin- and charge-density changes due to Cr atoms
- Short-range ordering
- MG borders, kinetics of its formation and activation energy
- σ-phase formation kinetics and activation energy for α→σ transformation
- Debye temperature of α- and σ-phase alloys
- Curie temperature of σ-phase alloys
- Dynamics of Fe atoms in Cr-rich alloys
- Effect of magnetism on Fe atoms dynamics in σ-phase alloys
- Magnetic re-entrance (FM→SG) in Cr-rich alloys

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