

Chemical characterization using spectroscopy techniques

Practical work- Surface Analysis Course 2024-25

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One group of students has to face the following surface analytical request described below.

The tasks are:

- Analyse the problem, identify needs.
- Propose a surface analysis strategy to solve the issue.
- Analyse the obtained data in order to extract the appropriate information

Prepare a short presentation (15 minutes) of the accomplished work and present it.

TP-3 Question:

You have been provided with a shape memory alloy, a smart material, composed of Fe-17Mn-6Si-10Cr-4Ni-1(V,C) (in weight %), which has undergone solution heat treatment at 1070°C for 2 hours to achieve compositional uniformity.

The user wants to know how the surface chemistry of the oxide film or passive film characteristics after the electrochemical passivation procedure.

Specifically, the technical questions are: How much is the thickness of this film? Which elements are present in the passive film of this multicomponent alloy? And what are the oxidation states of these elements?

For comparison the user is also recommended to compare non-treated sample which might have air-borne passive film.

References:

[1] Kulkarni, Pranav Vivek, Meet Jaydeepkumar Oza, Anna Igual-Munoz, Jean-Michel Sallese, Moslem Shahverdi, Christian Leinenbach, and Stefano Mischler. "Corrosion Behavior of Heat-Treated Fe-Based Shape Memory Alloys." *Materials and Corrosion* (2024) <https://onlinelibrary.wiley.com/doi/10.1002/maco.202414562>

[2] Collazo, A., R. Figueroa, C. Mariño-Martínez, X. R. Nóvoa, and C. Pérez. "Electrochemical characterization of a Fe-based shape memory alloy in an alkaline medium and the behaviour in aggressive conditions." *Electrochimica Acta* 444 (2023): 142034. <https://doi.org/10.1016/j.electacta.2023.142034>

TP-4 Question:

Stellite alloys are Co-Cr matrix-based alloys containing carbides. These alloys exhibit outstanding friction and wear properties associated to high corrosion resistance in aqueous media and at high temperature. They find application in the biomedical sector, nuclear power reactor and chemical installations.

The case: A Stellite alloy containing tungsten and molybdenum carbides (size 1-10 µm) surrounded by a CoCr matrix are exposed to oxidation in high temperature boiling water. In these conditions the CoCr matrix develops a thin passivating oxide layer on its surface. The question is to know whether the carbides also develop such film, and if yes, of which composition.