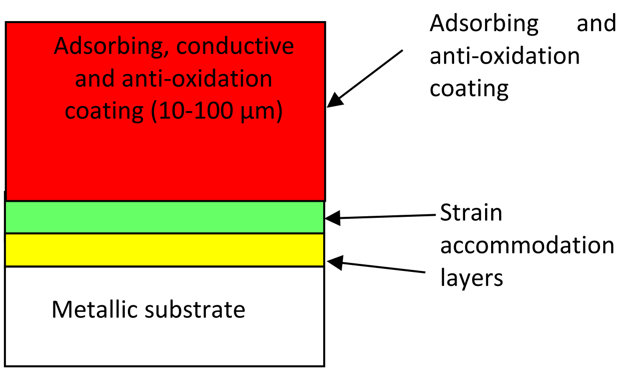
Multilayer multifunctional coatings for receivers in concentrated solar power plants

The extending market of the concentration solar power plants requires the use of high-temperature materials for two critical elements.
The first element is the **solar receiver** that has to convert the incoming concentrated solar flux into heat transferred to a coolant. The main bottleneck is to develop a surface that would absorb the largest possible spectrum of the incoming concentrated solar flux and present the lowest possible radiative losses. As the presence of a window would decrease the incoming solar flux, this surface is directly exposed to the atmospheric air, and may therefore oxidize, which could affect its optical properties. An **anticorrosive and spectral selective coating** could optimize the performance of this surface.
The research philosophy adopted in this research program is the design and development of an **optimal "coating system"** that optimizes the surface properties (spectral selectivity, resistance to oxidation and abrasion) of a high temperature metallic alloy chosen for its good thermal conductivity.
Using the High Temperature Chemical Vapor Deposition technique that was developed at SIMaP laboratory with the support of the SIL'TRONIX ST company, we expect to conceive multi-layers materials, with a ceramic coating on a metallic alloy, that would be able to support a working point beyond 1000°C, which would increase the yield of a solar power plant by 15 %. **The first objective will be the selection of candidates that fulfill (a) the requirements of stability in operating conditions (>1000 °C) and (b) the ability to be deposited by high temperature CVD in this range of temperature.**
The second objective is to determine what really happens in temperature-induced ageing phenomena in solar absorbers and heat exchangers. This investigation can be lead using the unique solar facilities available at PROMES-CNRS such as the REHPTS and MEDIASE facilities to be used for these experiments.
The first originality of this research program is to develop a multilayered and multifunctional system by (a) the addition of a coating on a known high temperature metallic alloy (e.g. molybdenum alloys) in the temperature range of operating conditions of the solar elements, (b) the management of mechanical and chemical compatibility of the coating with the others layers by the design of thin films barriers. **The second originality** of this project is the use of specific and unique facilities to evaluate the performance of the proposed stack.



Selection of a conductive, adsorbing and oxidation-resistant material: AlN and SiC are the first candidates

Selection of conductive materials to accommodate strain and diffusion: in situ etching (H_2 and nitrididation (NH_3) will be first used

Selection of a metallic alloy with high stability at HT : molybdenum alloys and/or alumina-formers alloys will be first studied

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