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MASTER'S INTERNSHIP

Modeling and Experimentation of Physicochemical Interactions Between High-Temperature Water Vapor and Materials

Context

Decarbonizing the aerospace sector requires breakthrough solutions, particularly involving hydrogen as an energy vector, which presents significant challenges in terms of energy efficiency and material durability. These challenges are particularly relevant under the combustion conditions anticipated, which combine high gas pressures with elevated temperatures, leading to significant water vapor production that may pose material-related issues. Questions such as hydrogen embrittlement of metals or sensitivity to corrosion must be thoroughly studied to ensure the optimal design of propulsion systems and the optimization of materials for these new usage conditions.

Objective

The objective is to study how high-temperature water, resulting from hydrogen combustion, penetrates materials via grain boundaries and interacts with their structure, causing damage. This internship is part of a broader project, which will be followed by a Ph.D. project aimed at combining experimental results from various devices to develop a relevant 1D numerical model of diffusion and material damage mechanisms. Initial experiments will address two major issues: first, evaluating the characteristic times associated with diffusional-reactive mechanisms within the solid; second, processing data and images from measurements to convert them into variables that can be theoretically and numerically exploited.

Tasks

The intern will conduct high-temperature oxidation kinetics measurements with and without water presence using thermogravimetric analysis (TGA). These analyses will be performed on nickel-based alloys available in single-crystal and polycrystalline versions. They will be complemented by microstructural analysis after oxidation and identification of the oxides formed. The analyses will provide information on the diffusion characteristic times of species, which are essential for feeding into the models.

Location: Institut Pprime, ENSMA - BP 40109, Téléport 2, 1 av Clément ADER, 86961 Futuroscope Chasseneuil Cedex

Internship Duration: 6 months with a stipend of €650 per month.

Candidate Profile: Master's student or a 3rd-year engineering school student

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