The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network.
The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a **PhD Position**

Keywords: Hypersonic flow, Aerothermal heating, Ablation by melting, Experimental fluid mechanics, CFD simulations

Investigation of the ablation by melting in hypersonic flow

Context

Future projectiles will fly at hypersonic speeds. At this velocity, the aerothermal heating increases drastically. As a result, all the stagnation regions of the projectile, especially the nose tip and the fins, are heated up and then are degraded by the flow. This process is called thermal ablation. In the case of metallic projectiles, it is an ablation by melting. The projectile surface melts and generates a liquid layer, which is sheared off by the flow. Ablation by melting involves a significant mass loss and shape changes, which finally lead to aerodynamic changes and structural failure.

Goals of the project

The present thesis aims to study the ablation by melting on fins. Experimental and numerical methods will be used to identify the main phenomena involved in the ablation of fins.
First, the wall heat flux on scaled fins will be measured in the high enthalpy shock tunnels. The dependence on various parameters, such as Mach number, Reynolds number and boundary layer thickness, will be studied. The possible viscous interaction effect will also be considered. This experiment aims to study the aerothermal heating in a hypersonic flow without ablation.
Ablation tests will also be performed in the shock tunnels. The ablation of fins made of a substitutive ablative material, such as gallium, will be measured. The goal is to determine the regions affected by the ablation or by a re-solidification of the ablated liquid layer. Comparisons with the wall heat flux measurements will be performed.
For the numerical investigation, the wall heat flux and the ablation experiments will be reproduced by CFD. For that purpose, the existing ISL code for ablation will be adapted for the fin geometry. The simulation will be used to validate the observations and conclusions drawn from the experimental part.

Candidate profile

- Master's degree in Physics, Material Sciences, Mechanics, Computational Mechanics or similar engineering discipline
- Experience in experimental and/or numerical fluid dynamics is advantageous
- English in speaking and writing
- French or German in speaking is advantageous
- Personal initiative, reliability, teamwork and communication skills

Benefits

- Ph.D. degree in the domain of Fluid Mechanics
- Multi-disciplinary experience
- Work in the international environment
- Competitive salary

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