Solid Hydrogen Extrusion Modeling

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Abstract

The Service des Basses Températures of CEA-Grenoble has developed a cryostat able to produce solid hydrogen ribbons of thickness between 50 and 100 µm. These ribbons are intended to be used in high-power laser facilities to study proton-laser interactions. The current developments are aiming at producing smaller ribbons thickness, down to 5-10 µm. Obtaining these thicknesses asks for a good comprehension of the physics of the extrusion coupled to a numerical study to estimate the extrusion parameters.
The solid hydrogen in the extrusion phase is generally considered as a non-Newtonian fluid. A low-temperature rheometer has been developed to characterize its properties. The modeling of extrusion experiments has been conducted based on the rheometer measurements. It has been performed with the COMSOL CFD module. The non-Newtonian behavior has been implemented through the use of a non-linear viscosity law extracted from the rheometer measurements.
We present the whole modeling process from the measurements to the viscosity law determination as well as the results of the modeling and the comparison to experiments.

Figures used in the abstract

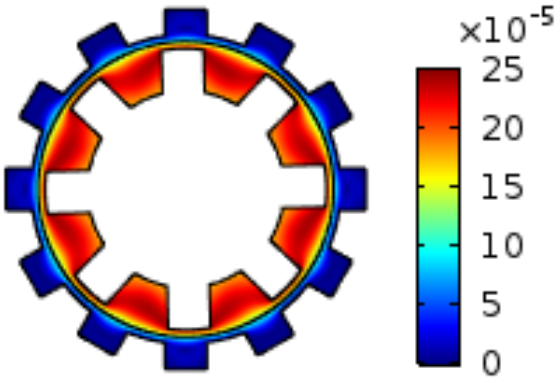

Figure 1: Velocity field of solid hydrogen (in m/s) in the low-temperature rheometer for a revolution of 0.008 1/s.