# A Plasma Torch Model

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## Abstract

Plasma torches are used in processing of materials and in energy industry for producing plasma. In this work we use the Equilibrium DC Discharge physics interface of COMSOL Multiphysics® to model a DC non- transferred arc plasma torch, under hypothesis of local thermodynamic equilibrium. However, to exploit the capability of the software, the model of the DC arc plasma torch is implemented by also using the following modules: CFD Module (Laminar Flow), Heat Transfer Module (Heat Transfer in Fluids/Solids), AC/DC Module (Electric Currents, Magnetic Fields) and Plasma Module (Equilibrium DC Discharge). Different geometries and boundary conditions values have been used in order to assess the performance of the DC torches. The steady state equations of conservation of fluid mechanics, heat transfer and electromagnetics are implemented by using the multiphysics couplings options available in the software. The plasma is considered optically thin and a net emission coefficient is used for the heat transferred by radiation mechanisms. Compressible laminar flows with swirl have been simulated for a plasma torch with argon as working gas. Furthermore, the swirling regime at the inlet of the torch has been introduced by using different combinations of free and forced flow. The computational results have been then compared with experimental results of literature available for the temperature and velocity patterns of the plasma torch.

## Figures used in the abstract

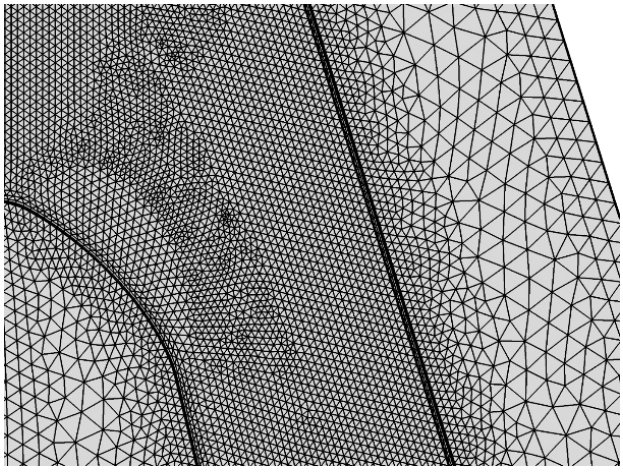

**Figure 1**: Partial view of the mesh between the cathode tip and anode wall.