Modeling the interaction of a high-enthalpy gas jet with a sample material

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The interaction of high-enthalpy flows with a solid body (sample) is an urgent problem of fluid dynamics and thermal physics of high-temperature media (both from the point of view of theory and experiment). Essentially, the problem is a model one and dates back to the high-speed movement of aircraft (space) vehicles in the atmosphere of the Earth and other planets, processes in rocket engines. To set up the problem correctly one need to create proper velocity (according to the Mach M and Reynolds Re numbers) and thermal regimes similar to those observed in a real flow around a body (in the re-entry flight). In experimental practice low-temperature plasma generators (plasma torches) with a power of several megawatts are used, which allow creating high-enthalpy plasma flows with temperatures up to $T = 10000$ K and velocities up to $T = 1 \ldots 1.2$ km/s. Note that despite the high gas velocities, the flow is subsonic due to the high speed of sound in the plasma. Indeed, it is more difficult to create the required high-speed regimes (according to the number M) using a plasma torch than thermal ones. To create a supersonic plasma flow, a high pressure in the discharge chamber is needed, which requires a higher breakdown voltage for ignition of the arc. The interaction of a high-enthalpy submerged jet with a sample made of a model material is calculated. Basing the model of conjugate heat transfer, phase transition and the mechanism of moving grids we obtain patterns of change in the sample shape, velocity distribution and temperature.

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