CALCULATION OF THE TEMPERATURE IN 3D CARBON-CARBON COMPOSITE MATERIAL.

Brykin M. V.

JIHT RAS, Moscow, Russia
mbrykin@gmail.com

The dynamics of the temperature field in a three-dimensional carbon-carbon composite material heated from the surface by a uniformly distributed heat flux (laser radiation) is calculated. It is shown that when only the radiative mechanism of the surface cooling is taken into account a region with a highly inhomogeneous temperature distribution is formed near it. The temperature drop reaches hundreds of K at the initial stage of heating and tens of K in a steady state. This effect is due to the strong anisotropy of the fibers thermal conductivity which differs by almost 2 orders of magnitude in the longitudinal and transverse directions. Accounting for the evaporative cooling mechanism caused by the sublimation of the material into a vacuum or an external inert atmosphere somewhat reduces the inhomogeneity of the temperature field on the surface. The evaporation rate was calculated taking into account the difference between the individual evaporation coefficients of different carbon vapor components from unity and the so-called parameter jumps in the Knudsen layer [1,2]. Its sharp dependence on temperature especially in the jet regime leads to a different rate of sublimation from different parts of the surface and the formation of its complex relief. In particular, the initial complete structure of the material breaks down which can lead to its more rapid destruction in comparison with the sublimation mechanism as a result of cracking due to arising thermal stresses. It is shown that, although the rates of evaporation into vacuum and a medium at the same surface temperature differ very strongly, in the steady state this difference is practically leveled by the difference in the established average surface temperature.

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