

Hydraulic resistance and convective heat transfer within independent power generation micro sources (IPM) channels

Sudarev A.V., Sudarev B.V., Suryaninov A.A.

Research Center «Ceramic Engines» named after A.M. Boyko Polyustrovsky Av., 15, block 2, 195221, St-Petersburg, Russia

E-mail: soudarev@boykocenter.spb.ru

Abstract

The introduction of new structural materials and technologies contributes to the efficiency increase for the compact IPMs used in various branches of engineering. Use of a driving high-temperature (TIT>1600K), regenerative (the regeneration ratio is $E>85\%$) micro gas turbine engine μ GTE, major components of which are made of structural ceramics, allows not only to maintain the effective efficiency at $\eta_e=26-30\%$, but, also, sharply reduce the material consumption rate for the micro source as a whole.

Application of the laser prototyping technique to manufacture the air heater, which is a part of μ GTE, increases the IPM compactness. Miniaturization of the air heater, manufactured by the structural ceramics laser fusion, can significantly reduce the hydraulic diameter ($d_h \leq 1.0$ mm) of the channels, designed to transport the working media inside it. Reducing d_h leads to a significant increase in the hydraulic resistance of the micro channels. The associated increase in the energy consumption for μ GTE's own needs is compensated by increasing the TIT, E, and heat transfer coefficients in micro channels, and by eliminating the need in cooling for high temperature IPM components.