[0238] Inlet velocity=1.54 m/s

[0239] Inlet temperature=300 K

[0240] Wall temperature=350 K

The Reynolds number of the fluid in the channel was 1000. The Reynolds number was calculated as

$$Re = \frac{\rho v D}{\mu}$$

where

[0241] ρ=density of fluid, kg/m^3

[0242] v=Velocity of fluid, m/s

[0243] D=Hydraulic diameter of channel, m

[0244] μ=Viscosity of fluid, kg/m/s

The overall heat transfer coefficient was estimated as

$$HTC_{overall} = \frac{\dot{Q}_{wall}}{A_{flat}(LMTD)}$$

where

[0245] $HTC_{overall}$=Overall heat transfer coefficient (W/m^2/K)

[0246] Q_{wall}=Heat transferred from wall (W)

[0247] A_{flat}=Heat transfer area based on smooth (or no surface feature) geometry, m^2

[0248] LMTD=Log mean temperature difference

Model Chosen

K-Omega model (SST type) was chosen for CFD analysis. The values of model constants were default values provided by Fluent 6.0. Full multi-component diffusion species transport model was chosen. The diffusivity was 1E-5 m^2/s.

Results

[0249] FIG. **7** shows the comparison of temperature profile between the flat channel (no surface feature) and channel with surface feature geometries. The temperature profile was plotted at the center of the channel along the flow direction. All temperatures are in degrees Kelvin. Heat transferred from the wall to the fluid faster for the geometry with surface features. The Table below compares calculated heat transfer coefficient for flat channel and surface feature geometry. The results showed an improvement of heat transfer coefficient of 143% and pressure drop increase of 63% for the geometry with surface features relative to the case without surface features. Note that the relative improvement in heat transfer is greater that relative increase in pressure drop. Further note that to achieve equal performance as for a flat channel of 1.4 inches in length, only a 0.3 inch long channel with surface features is required.

TABLE

Comparison of heat transfer coefficient and pressure drop between flat channel and surface feature geometry for 0.0125 inch gap

	Flat Channel	SFG-1
Inlet Velocity (m/s)	1.54	1.54
Reynolds number	~1000	~1000
% increase in area		39%
HTC (W/m2/K)	12076	29339
% HTC Improvement		143%
Pressure Drop (psi)	1.2	1.9
% Pressure drop increase		63%

Case 2: 0.040 Inch Channel Gap

Using Gas as the fluid:

Boundary Conditions

[0250] Operating pressure=345 psi

[0251] Outlet pressure=0 psig

[0252] Inlet velocity=0.47 m/s

[0253] Inlet temperature=300 K

[0254] Wall temperature=350 K

Using liquid water as the fluid:

Boundary Conditions

[0255] Operating pressure=14.7 psi

[0256] Outlet pressure=0 psig

[0257] Inlet velocity=0.60 m/s

[0258] Inlet temperature=300 K

[0259] Wall temperature=350 K

The Reynolds number of the fluid in the channel was 1000.

Model Chosen

K-Omega model (SST type) was chosen for CFD analysis. The values of model constants were default values provided by Fluent 6.0.

Full multi-component diffusion species transport model was chosen. The diffusivity was 1E-5 m^2/s.

Results

[0260] For this larger gap, the geometry with surface features still shows a heat transfer enhancement over the flat geometry. Table 2 compares the heat transfer coefficient and pressure drop between the flat geometry and the geometry with surface features.