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## NOMENCLATURE

$D_j$	Jet diameter at the injection pipe exit (mm)
$f$	Oscillation frequency of time periodic flow (Hz)
$F$	Non-dimensional oscillation frequency, $f/(\alpha/H^2)$
$g$	Gravitational acceleration ( $\text{mm/s}^2$ )
$Gr$	Grashof number, $g\beta\Delta TH^3/\nu^2$
$Gr/Re_j^2$	Critical buoyancy-to-inertia ratio for the onset of buoyancy induced roll
$H$	Distance between the exit of injection pipe and heated plate (mm)
$Q_j$	Jet flow rate (Standard Liter per Minute, slpm)
$r_s$	The center of the location of secondary inertia-driven roll (mm)
$r, \theta, z$	Dimensional cylindrical coordinates
$R, \Theta, Z$	Dimensionless cylindrical coordinates, $r/R_c, \theta, z/H$
$Ra$	Rayleigh number, $g\beta\Delta TH^3/\alpha\nu$
$R_c$	Radius of processing chamber (mm)
$Re_j$	Jet Reynolds number, $\bar{V}_j D_j/\nu$
$Re_w$	Local Reynolds number in the wall-jet region, $\bar{u}H/\nu$
$Re_{we}$	Local Reynolds number in the wall-jet region at the edge of heated disk
$S_I$	Size of primary inertia-driven roll (mm)
$S_O$	Size of buoyancy-driven roll (mm)
$T_f$	Temperature of the heated disk ( $^{\circ}\text{C}$ )
$T_j$	Temperature of jet at the injection pipe exit ( $^{\circ}\text{C}$ )
$t$	Time (sec)
$\bar{u}$	Average velocity of the flow at wall-jet region (mm/s), $(Re_j D_j \nu)/(8rH)$
$\bar{V}_j$	Average velocity of the air jet at the injection pipe exit (mm/s)

### **Greek symbols**

$\alpha$	Thermal diffusivity ( $\text{mm}^2/\text{s}$ )
$\beta$	Thermal expansion coefficient ( $1/\text{K}$ )
$\Delta T$	Temperature difference between the heated disk and the injected air ( $^{\circ}\text{C}$ )
$\nu$	Kinematic viscosity ( $\text{mm}^2/\text{s}$ )
$\Phi$	Non-dimensional temperature, $(T - T_j)/(\bar{T}_f - T_j)$

### **Superscript**

—	Average
---	---------

### **Subscripts**

c	Processing chamber
e	Edge of heated disk
f	Fluid, Air
j	Jet impinging
I	Primary inertia-driven roll
O	Buoyancy-driven roll
s	Secondary inertia-driven roll
w	Wall-jet region