List of Symbols

Some symbols and abbreviations which are common throughout the book are given below. They have also been explained in the text, occasionally, but not every time they occur. In addition to these symbols, several other symbols have been used in the text, and they have been explained at the places they occur. The parameters occurring in the equations could be dimensionless quantities or may have dimensions. At those places where the equations are in the dimensionless form, the method of dimensionalization has been mentioned or referred to reference indicated in the text.

For the notations used for the function spaces, the reader is referred to Appendices A–D. The same have been explained in the text, occasionally.

Standard notations have been used for the numbering of equations, figures, definitions and propositions. For example, Eq. (7.2.7) refers to the seventh equation in the second section of Chapter 7.

$c(x,t)$, $\bar{c}(x,t)$	concentration ($\mathrm{kg\,m^{-3}}$)
C	specific heat ($\mathrm{J\,kg^{-1}\,K^{-1}}$)
C_V	specific heat at constant volume
C_P	specific heat at constant pressure
$\hat{C}$	heat capacity ($\mathrm{J\,K^{-1}\,m^{-3}}$)
e	specific internal energy ($\mathrm{J\,kg^{-1}}$); also used for energy per unit volume (indicated in the text)
H	enthalpy (J); also enthalpy per unit volume (indicated in the text)
h	specific enthalpy ($\mathrm{J\,kg^{-1}}$)
h_t	heat transfer coefficient ($\mathrm{W\,K^{-1}\,m^{-2}}$)
k	thermal diffusivity ($\mathrm{m^2\,s^{-1}}$)
K	thermal conductivity in the isotropic case ($\mathrm{J\,m^{-1}\,s^{-1}\,K^{-1}}$)
K_{ij}	thermal conductivity coefficients in an anisotropic case; $i = 1, 2, 3$ and $j = 1, 2, 3$
$\bar{K}_c$	mean curvature of the free boundary ($\mathrm{m^{-1}}$)
l	latent heat of fusion ($\mathrm{J\,kg^{-1}}$)
l_m	latent heat per unit mole ($\mathrm{J\,kmol^{-1}}$)
$\hat{l}$	$l + (C_L - C_S)T_m$
R^n	$n \geq 1$, real n-dimensional space, R or R^1 used for real line
$S(t)$	$x = S(t)$ ($x = S(y, z, t)$), equation of the phase-change boundary in one-dimension (three-dimension)

$\hat{s}$	specific entropy ($\mathrm{J\,kg^{-1}\,K^{-1}}$)
$\hat{S}$	entropy ($\mathrm{J\,K^{-1}}$)
t	real time (s)
T	temperature (K)
T_m	ideal equilibrium melting/freezing temperature, also taken as 0 or 1
T_m^c	equilibrium phase change temperature in supercooling/superheating
V_m	molar volume ($\mathrm{m^3\,kmol^{-1}}$)
$\vec{n}$	unit normal vector

Subscripts

(L, S, M)	liquid, solid and mushy regions
$i = 1, 2$	quantities in the two phases

Greek Symbols

ρ	density ($\mathrm{kg\,m^{-3}}$)
σ	surface tension ($\mathrm{N\,m^{-1}}$)

Some Other Symbols

$'$	differentiation with respect to the argument
$\cdot$	time derivative
∇f	gradient of a scalar function
∇^2	Laplacian operator
$\mathrm{Ei}(x)$	Exponential integral
$\mathrm{erf}(x)$	error function
$\mathrm{erfc}(x)$	$1 - \mathrm{erf}(x)$
$i^n\mathrm{erfe}(x)$	Iterated error function

Abbreviations

meas (A)	measure of the set A
ADM	Adomian decomposition method
ARIM	Alternate refined heat balance integral method
CEF	classical enthalpy formulation
CES	classical enthalpy solution

CODP	constrained oxygen-diffusion problem
CSS	classical Stefan solution
EHBIM	Enthalpy heat balance integral method
HAM	Homotopy analysis method
HBIM	Heat balance integral method
HPM	Homotopy pertubation method
HSP	Hele-Shaw problem
MIM	Method of integral manifold
MWR	Method of weighted residual
ODP	oxygen-diffusion problem
QSSP	quasi steady-state problem
RHBM, RIM	Refined heat balance integral method
SPF	standard phase-field model
SSP	supercooled Stefan problem
UODP	unconstrained ODP
WS	weak solution