Thermal Conductivity and Metal Oxide Gas Sensors: Micromachining as an Opportunity to Improve Sensor Performance

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Wärmeleitfähigkeits- und Metalloxid-Gassensoren: Mikromechanik als Chance zur Verbesserung der Sensoreigenschaften

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Frequently used Abbreviations, Constants and Variables

List of Abbreviations

Symbol	Description
CO	carbon monoxide
CVD	chemical vapor deposition
H_2	hydrogen
He	helium
NO	nitrogen monoxide
NO_2	nitrogen dioxide
ppb	pars per billion
ppm	pars per million
PVD	physical vapor deposition
RGTO	rheotaxial growth and thermal oxidation
r.H.	relative humidity
Si	silicon
SiO_2	silicon oxide
SnO_2	tin dioxide

List of Constants

Symbol	Description	Units
σ	Stefan-Boltzmann constant	$5.67051 \cdot 10^{-8} \mathrm{Wm}^{-2}\mathrm{K}^{-4}$
k	Boltzmann's constant	1.3805 x $10^{-23} JK^{-1}$
N_A	Avagadro's number	6.022 x 10^{23} molecules/mole

List of Variables

Symbol	Description	Units
A	area	m^2
a_e	energy accomodation coefficient	-
c_p	specific heat	$\mathrm{J\,kg^{-1}K^{-1}}$
C_{therm}	thermal capacity	$\mathrm{J\,K^{-1}}$
d	thickness of the membrane	m
G_m	geometry factor describing heat loss through the membrane	m
G_{gas}	geometry factor describing heat loss through the gas	m
l_{heat}	heater edge length	m
l_{mem}	membrane edge length	m
$\bar{l}$	mean free path between collisions	m
L	distance to heat sink	m
m_i	sensitivity to a gas species i	$\mathrm{ppm^{-1}}$
p	pressure	Pa
P	heating power	W
Q	heat flux	W
R	electrical resistance	Ω^{-1}
R_{therm}	thermal resistance	$\mathrm{K\,W^{-1}}$
S	sensor response or signal	-
T	temperature	K
T_{amb}	ambient temperature	K
T_{hot}	heater temperature	K
$\triangle T$	temperature difference	K
α_m	mean heat transfer coefficient	$\mathrm{W\,m^{-2}K^{-1}}$
β	linear temperature coefficient	$\mathrm{K^{-1}}$
ε	emissitivity	-
ζ	analytical sensitivity	$\mathrm{ppm^{-1}}$
η	transduction efficiency	-
λ	thermal conductivity	$\mathrm{W\,m^{-1}K^{-1}}$
λ_m	thermal conductivity of the membrane	$\mathrm{W\,m^{-1}K^{-1}}$
λ_{air}	thermal conductivity of air	$\mathrm{W\,m^{-1}K^{-1}}$
λ_{gas}	thermal conductivity of gas	$\mathrm{W\,m^{-1}K^{-1}}$
λ_{He}	thermal conductivity of helium	$\mathrm{W\,m^{-1}K^{-1}}$
ϱ	density	$\mathrm{kg\,m^{-3}}$
τ	time constant	s