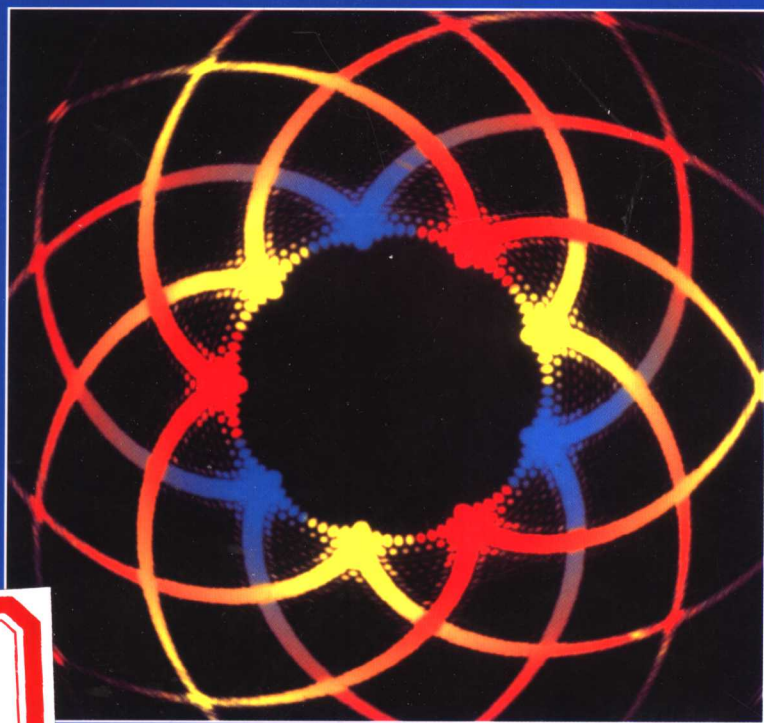


纳米材料表征

Characterization of Nanophase Materials

[美] 王中林 主编
曹茂盛 李金刚 译



化学工业出版社

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译者前言

本书根据 WILEY-VCH 图书出版公司出版的“Characterization of Nanophase Materials”译出。该书英文版由长期从事纳米材料科学研究的科学家及著名学者编写而成，内容汇集了他们在纳米材料科学与技术领域取得的最新成就。本书介绍了纳米材料的结构表征方法，主要包括纳米粒子的 XRD 表征、纳米粒子透射电子显微镜及光谱分析、纳米粒子的扫描透射电子显微术、纳米团簇的扫描探针显微术、纳米材料光谱学和自组装纳米结构材料的核磁共振表征。此外，本书还介绍了纳米材料的电学、磁学、光学、电化学等性质。

本书是纳米材料表征方面的一部系统、完整的科技参考书，可供研究院所的研究人员参考使用，特别适合高等院校相关专业的本科生、研究生、教师以及科技工作者参考阅读。

本书由曹茂盛、李金刚翻译。此外，赵玉娜、邹桂真、崔文龙、白羽、史学峰、张永、雷义龙、林海波、李直蔓等也参加了部分章节的翻译和校稿工作。

在本书翻译和策划过程中，化学工业出版社给予了很多关心和支持，在此，译者对他们的辛勤劳动表示衷心感谢。

曹茂盛

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符号说明英汉对照表

a	lattice parameter	晶格常数
A	area of an electrode	电极面积
A_d	area on the CRT display	CRT 显示区面积
$A(\mathbf{K})$	aperture function	孔径函数
$A(k)$	backscattering amplitude	背散射振幅
A_s	area scanned on the sample	样品扫描面积
B	magnetic field	磁场
c	lattice parameter	晶格常数
c	spring constant of the cantilever	悬臂弹性常数
c	elastic constant	弹性常数
C_0	capacitance of the empty cell used for transfer function measurement, $C_0 = \epsilon_0 A/d$	传递函数测量空胞电容
$C_{1/2}$	capacities	电容量
C_{dl}	double-layer capacitance	双电层电容
C_i	sensitivity constant derived from the Sauerbrey relationship	Sauerbrey 关系敏感常数
c_j^*	concentration of species j	j 类浓度
c_j	bulk concentration of species j	j 类块体浓度
C_s	spherical aberration coefficient	球差系数
d	distance	间距
d	resonator thickness	共振器厚度
d	separation between two parallel electrode in an impedance measurement	平行电极间隙 (阻抗测量中)
d	thickness	厚度
D	Debye-Waller factor	德拜-沃勒因子
D_j	diffusion coefficient of species j	j 类扩散系数
$D(\mathbf{K})$	transmission function of the detector	探测器穿透函数
D_0	dissipation coefficient corresponding to the energy losses during oscillation	谐振能量损失耗散系数
E	photoelectron energy	光电子能量
E	polarization of the emitted light	发射光偏振
E	voltage or electric potential	电压或电势
ΔE	Stark shift	斯塔克位移

E_0	accelerating voltage	加速电压
E_0	threshold energy	阈值能量
$E_{1/2}$	half-wave potential (in voltammetry)	半波势 (伏安法中)
E_b	biexciton binding energy	双激子束缚能
E_i	initial potential	初始势能
E_p	peak potential	峰值势能
ΔE_p	$ E_p^A - E_p^C $ in CV	$ E_p^A - E_p^C $ (CV)
$E_{p/2}$	potential where $I = I_p/2$ in LSV or CV	对应于 $I = I_p/2$ (LSV 或 CV) 的势能
F	electric field	电场
F	faraday constant, $F = 96485$ C/mol	法拉第常数, $F = 96485$ C/mol
F	net force	净力
Δf	lens defocus	透镜散焦
Δf	measured frequency change	被测频率变化
f_0	frequency of a quartz resonator prior to a mass change	质量变化前的石英共振频率
$F'(d)$	force gradient	压力梯度
$F(\bar{k})$	structure amplitude	结构振幅
$f(s)$	scattering factor	散射因子
$FT[V_P(\mathbf{b})]$	Fourier transform of the crystal potential	晶体势傅里叶变换
F_z	attractive force	吸引力
\mathbf{G}	reciprocal lattice vector	倒易晶格矢量
h	piezoelectric stress constant	压电应力常数
H	total Hamiltonian	总哈密顿量
I	transmitted intensity	穿透强度
I	tunneling current	隧道电流
I_0	incident beam intensity	入射束强度
$I_0(\mathbf{x})$	intensity distribution of the incident probe	入射探针的强度分布
$I_0(\Delta)$	integrated intensity of the low-loss region including the zero-loss peak for an energy window Δ	包括零损耗峰的低损耗区域的 集成强度 (对应能量窗口 Δ)
i_t	faraday current	法拉第电流
$I_N(s)$	power scattered per unit solid angle in the direction defined by s	单位立体角内的散射功率 (由 s 定义的方向)
I_P	peak current	峰值电流
i_r	current during reversal step	反向阶段的电流
I_{SE}	total integrated SE intensity	二次电子的总强度
$I(\mathbf{X})$	image intensity	图像强度
j	coordination shell index	配位壳层指数

j	imaginary unit, $j = (-1)^{1/2}$	虚部单位, $j = (-1)^{1/2}$
J	net electronic angular momentum	纯电子角动量
J_0	exchange current density	交换电流密度
J_{ij}	exchange energy constants	交换能量常数
J_n	Bessel functions of order n	n 阶贝塞尔函数
k	electron wave vector	电子波矢
k	spring constant	弹簧常数
K	anisotropy energy	各向异性能
\bar{K}	wave vector of the scattered wave	散射波波矢
K_0	cut-off wave vector	截止波矢
\bar{K}_0	wave vector of the incident wave	入射波波矢
k°	standard heterogeneous rate constant	标准不均匀率常数
k_F	Fermi wave vector	费米波矢
l	length	长度
L	average escape-depth	平均逸出深度
L	total orbital angular momentum	总轨道角动量
L_d	thickness of a Nernst diffusion layer	能斯特扩散层厚度
m	electron mass	电子质量
M	magnetization	磁化强度
M	magnification	放大倍数
Δm	mass change	质量变化
$M_r(\omega)$	modulus function, $M_r(\omega) = [\epsilon_r(\omega)]^{-1}$	模量函数
M_w	apparent molar mass	重均分子量
$M_{\mu\nu}$	tunneling matrix element	隧道穿透矩阵元
n	density	密度
n	number of electrons involved in an electrochemical process	涉及电化学过程的电子数
N	number of identical atoms in the same coordination shell	同一配位壳层中一致的原子数
p	momentum	动量
$P(\mathbf{b}, \Delta z)$	propagation function	传播函数
P_{Lm}	associated Legendre function	缔合勒让德函数
P_j	depolarization factors for the three axes A, B, C of the nanorod with $A > B = C$	对应 $A > B = C$ 的纳米棒 A, B, C 三轴的去极化因子
Q	charge	电荷
$Q(\mathbf{b}, z + \Delta z)$	phase grating function of the slice	薄片相栅函数
Q_{dl}	charge due to double layer charging	双电层充电电荷
$Q(\mathbf{K})$	Fourier transform of the object transmission function	目标透射函数傅里叶变换

$q(x)$	transmission function of the object	目标透射函数
r	distance between absorbing and neighbor atoms	吸收与邻近原子间距
R	gas constant	气体常数
R	radius	半径
R	resistance	电阻
R_b	bulk resistance of a electrode	电极块体电阻
R_{ct}	resistance to charge transfer at electrolyte-electrode interfaces	电解液-电极界面电荷转移电阻
r_m	radius	半径
r_{mn}	distance between atom m and atom n	原子 m 和 n 的间距
R_{mt}	steady state mass transfer resistance	稳态质量转移阻力
S	local spin angular momentum	局域自旋角动量
$S_0^2(k)$	amplitude reduction factor due to many-body effect	多体效应导致的振幅换算系数
S_i	spin operator of i^{th} electron	第 i 个电子自旋算符
t	time	时间
T	absolute temperature	绝对温度
T	material thickness	材料厚度
T_1	energy relaxation	能量弛豫
T_2	dephasing time	退相时间
T_c	Curie temperature	居里温度
$T(\mathbf{K})$	transfer function of the microscope	显微镜传递函数
$t_{\text{obj}}(x, y)$	inverse Fourier transform of $T(\mathbf{K})$	$T(\mathbf{K})$ 的逆傅里叶变换
$t(\mathbf{x})$	amplitude distribution of the incident probe	入射探针振幅分布
\mathbf{u}	reciprocal space vector	倒易空间矢量
U	tunneling voltage	隧道电压
U_0	acceleration voltage	加速电压
V	linear potential scan rate	线性势扫描速率
V	electron velocity	电子速率
V	volume	体积
V_m	molar volume	摩尔体积
$V_p(\mathbf{b})$	thickness-projected potential of the crystal	晶体的厚度投射势
W	distance between tip and Sample	针尖与样品间距
\mathbf{X}	beam position	波束位置
Δx	rms atomic displacement	rms 原子位移
x_0	impact parameter	碰撞参数
$Y(\omega)$	$Y(\omega) = [Z(\omega)]^{-1}$, admittance function	$Y(\omega) = [Z(\omega)]^{-1}$, 导纳函数
Δz	displacement of the cantilever and piezo	悬臂梁与压力间的位移

Z_w	Warbug impedance	沃伯格阻抗
$Z(\omega)$	impedance function	阻抗函数
α, β	angle	角度
α, β	parameters	参数
α_a, α_c	anodic and cathodic charge transfer coefficient	阳极-阴极电荷转移系数
β	asymmetry parameter for a one-electron process	单电子过程的非对称参数
$\chi(k)$	EXAFS oscillations	EXAFS 谐振
$\chi(\mathbf{K})$	aberration function of the objective lens	物镜色差函数
$\chi(T)$	magnetic susceptibility	磁化率
$\chi(\sigma t)$	tabulated number	列表数
Δ	defocus value	散焦值
δ	temporal phase angle between the charging current and the total current	瞬时相角 (荷电电流与总电流之间)
ϵ_0	absolute permittivity (or the permittivity of free space)	绝对介电常数 (或自由空间介电常数)
ϵ_m	dielectric constant	介电常数
ϵ_Q	dielectric constant of quartz	石英介电常数
ϵ_r	relative permittivity of a material	材料相对介电常数
ϵ_r'	dielectric constant	介电常数
$\epsilon(\omega)$	dielectric function	介电函数
ϕ	tilt angle between μ and sample plane	μ 和样品间的 Δ 角
ϕ	total photoelectron phase shift	总光电子相移
ϕ	workfunction	功函数
$\phi(k)$	total phase shift	总相移
$\phi(r)$	electronic ground state wave function	电子基态波函数
$\phi(x)$	projected specimen potential along the incident beam direction	沿入射方向的出射样品势
λ	wavelength	波长
$\lambda(k)$	photoelectron mean free path	光电子平均自由程
μ	absorption coefficient	吸收系数
μ	paramagnetic atom	顺磁性原子
$\boldsymbol{\mu}$	transition dipole vector	跃迁偶极子矢量
μ_0	atomic absorption coefficient	原子吸收系数
μ_B	Bohr magneton	玻尔磁子
$\mu(E)$	absorption coefficient associated with a particular edge	特殊边相关吸收系数
$\Delta\mu(E)$	change in the atomic absorption across the edge	穿越边缘的原子吸收变化
$\mu_0(E)$	absorption coefficient of an isolated gold atom	孤立金原子的吸收系数
μ_{exc}	exciton dipole moment	激发子偶极矩

μ_Q	shear modulus of AT-cut quartz	AT-断口石英剪切模量
μ_S	net surface dipole moment	净表面偶极矩
v_{tr}	transverse velocity of sound in AT-cut quartz (3.34×10^4 m/s)	AT-断口石英内部横向声速
θ	angle between emission polarization and projection of μ onto the sample plane	样品表面发射偏振和 μ 发射之间的角度
θ	scattering angle	散射角
θ	temporal phase angle	瞬时相位角
θ_B	Bragg diffraction angle	布拉格衍射角
ρ_Q	density of quartz	石英密度
ρ_S	density of states of sample	样品态密度
$\rho_S(z, E)$	local density of states of the sample	样品局域态密度
ρ_T	density of states of tip	针尖态密度
σ	atomic scattering cross-section	原子散射截面
σ	interaction constant	相互作用常数
σ	total Debye-Waller factor (including static and dynamic contributions)	总德拜-沃勒因子 (包括静态和动态的贡献)
$\sigma_{i,el}$	ionic conductivity of an electrolyte	电解质离子电导
$\sigma_A(\Delta, \beta)$	energy and angular integrated ionization cross-section	能量和角度的综合离子化横截面
σ_{ext}	total extinction coefficient	总消光系数
τ	forward step duration time in a double-step experiment	双阶实验的前阶持续时间
τ	relaxation time	弛豫时间
ω	angular frequency	角频率
Ω	atomic volume	原子体积
Ψ	total electronic wave function	总电子波函数
$\Psi(\mathbf{K})$	exit wave function	出射波函数
$\Psi(\mathbf{K}, \mathbf{X})$	amplitude function	幅值函数
$\Psi(\mathbf{u})$	Fourier transform of the wave	波的傅里叶变换
$\Psi(x, y)$	transmitted wave function	透射波函数

缩略语英汉对照表

ADF	annular dark-field	环形暗场
AE	Auger electron	俄歇电子
AFM	atomic force microscopy	原子力显微镜
bcc	body-centered cubic	体心立方
BF	bright-field	明场
CA	chronoamperometry	计时电流分析法
CB	conduction band	导带
CBED	convergent beam electron-diffraction	会聚束电子衍射
CCD	charge coupled device	电荷耦合器件
CCM	constant current mode	恒电流模式
CE	counter electrode	计数电极
CEND	coherent electron nanodiffraction	相干电子纳米衍射
CHA	concentric hemispherical analyzer	同心半球分析器
CHM	constant height mode	恒高度模式
CID	chemical interface damping	化学界面阻尼
C. L.	cathodoluminescence	阴极发光
CMA	cylindrical mirror analyzer	柱面镜分析器
CP	cross-polarization	横向极化
CPR	current pulse relaxation	电流脉冲弛豫
CRT	cathode-ray-tube	阴极射线管
CTAB	cetyltrimethylammonium bromide	溴化十六烷基三甲基铵
CTAC	cetyltrimethylammonium chloride	氯化十六烷基三甲基铵
CTF	contrast transfer function	比较传递函数
CV	cyclic voltammetry	循环伏安法
DAS	dynamic-angle spinning	动力学角自旋
dec	decahedron	十面体
DiI	1,1'-dioctadecyl-3,3,3',3'- tetramethylindocarbocyanine	1,1'-二(十八烷)-3,3,3',3'-四甲基靛炭菁蓝
DFA	Debye function analysis	德拜函数分析
DOR	double-rotation	双旋转
DSTEM	dedicated scanning transmission electron microscopy	专用扫描透射电子显微镜
EDS	energy dispersive X-ray spectroscopy	能量分散 X 射线谱
EELS	energy-loss spectroscopy	能量损失谱

EFM	electric force microscopy	电场力显微镜
EF-TEM	energy-filtered transmission electron microscopy	能量过滤透射电子显微镜
ELD	electroless deposition	化学沉积
ELNES	energy-loss near edge structure	能量损失近边结构
EQCM	electrochemical quartz crystal microbalance	电化学石英晶体微天平
EXAFS	extended X-ray absorption fine structure	扩展 X 射线吸收精细结构
fcc	face-centered-cubic	面心立方
FEG	field-emission gun	场发射枪
FE-SAM	field emission scanning Auger microscopy	场发射扫描俄歇显微镜
FE-TEM	field-emission transmission electron microscopy	场发射透射电子显微镜
FFM	frictional force microscopy	摩擦力显微镜
FLDOS	local density of states near the Fermi energy	邻近费米能的局域态密度
FM	frequency modulation	频率调制
FMM	force modulation microscopy	力调制显微镜
FWHM	full-width-at-half-maximum	半宽度
GITT	galvanostatic intermittent titration technique	趋电性间歇滴定技术
GMR	giant magnetoresistance	巨磁阻
HAADF	high-angle annular dark-field	高角度环形暗场
HOMO	highest occupied molecular orbital	最高占据分子轨道
HOPG	highly oriented pyrolytic graphite	高取向热解石墨
HRTEM	high resolution transmission electron microscopy	高分辨透射电子显微镜
ico	icosahedron	二十面体
IR	infrared spectroscopy	红外光谱
IS	impedance spectroscopy	阻抗谱
LABF	large angle bright-field	大角明场
LB	Langmuir-Blodgett	Langmuir-Blodgett
LNLS	Brazilian National Synchrotron Laboratory	巴西国家同步加速器实验室
LO	longitudinal-optical	纵向光学
LSV	linear sweep voltammetry	线性扫描伏安法
LTS	local tunneling spectroscopy	局域隧道谱
LT-STM	low-temperature scanning tunneling microscopy	低温扫描隧道显微镜
LUMO	lowest unoccupied molecular orbital	最低未占据分子轨道
MAS	magic angle spinning	幻角自旋
MECS	multiple expansion cluster source	多重扩展团簇源
MFM	magnetic force microscopy	磁力显微镜
MIDAS	microscope for imaging, diffraction, and analysis of surfaces	成像、衍射和表面分析显微镜
MIEC	mixed ionic-electronic conductor	离子电子混合导体

MTP	multiply-twinned particles	多重孪晶粒子
NCA	nanocrystal arrays	纳米晶体阵列
NCS	nanocrystal superlattices	纳米晶超晶格
NMR	nuclear magnetic resonance	核磁共振
NQ	naphthoquinone	萘醌
NSOM	near-field scanning optical microscopy	近场扫描光学显微镜
OCV	open-circuit voltage	开路电压
OD	optical density	光学密度
ODPA	octadecylphosphonate	十八烷膦酸酯
PCTF	phase-contrast transfer function	相衬转换函数
PEELS	parallel electron energy-loss spectroscopy	平行电子能量损失谱
PL	photoluminescence	光致发光
POA	phase object approximation	相目标近似
PS	polystyrene	聚苯乙烯
PSD	position-sensitive detector	位置敏感探测器
PSP	poly (styrenephosphonate diethyl ester)	聚苯乙烯膦酸二乙酯
PVK	polyvinyl carbazole	聚乙烯基咔唑
PVP	poly (2-vinylpyridine)	聚二乙烯吡啶
QCM	quartz crystal microbalance	石英晶体微量天平
QCNB	quartz crystal nanobalance	石英晶体纳米天平
QDQW	quantum-dot quantum-well	量子点量子阱
QDs	quantum dots	量子点
RE	reference electrode	参比电极
REDOR	rotational-echo double resonance	回旋双共振
ROMP	ring-opening metathesis polymerization	开环交换聚合
SA	self-assembly	自组装
SAM	scanning Auger microscopy	扫描俄歇显微术
SAMs	self-assembled monolayers	自组装单分子层
SAXS	small-angle elastic X-ray scattering	小角弹性 X 射线散射
SCAM	scanning capacitance microscopy	扫描电容显微镜方法
SE	secondary electron	二次电子
SEMPA	scanning electron microscopy with polarization analysis	偏振分析式扫描电子显微术
SEDOR	spin-echo double resonance	自旋回转双共振
SES	lower case secondary electron spectroscopy	小写的二次电子谱
SET	single-electron tunneling	单电子隧道
SFM	scanning force microscopy	扫描力显微镜
SNOM	scanning near-held optical microscopy	扫描近场光学显微镜

SP	single-pulse	单脉冲
SPM	scanning probe microscopy	扫描探针显微镜
SPs	surface plasmons	表面等离子体
STEM	scanning transmission electron microscopy	扫描透射电子显微镜
STM	scanning tunneling microscopy	扫描隧道显微镜
STS	scanning tunneling spectroscopy	扫描隧道谱
T3	2,5 ^{'''} -bis(acetylthio)-5,2',5',2''-terthienyl	2,5 ^{'''} -二(乙酰基硫醇)-5,2',5',2''-三噻吩
TAD	thin annular detector	薄环状探测器
TADBF	thin annular detector for bright-field	明场薄环状探测器
TADDF	thin annular detector for dark-field	暗场薄环状探测器
TEM	transmission electron microscopy	透射电子显微镜
TDS	thermal diffuse scattering	热扩散散射
TO	truncated octahedral	平截八面体
TP	thiophenol	苯硫酚
UHV	ultrahigh vacuum	超高真空
VB	valence band	价带
VOA	virtual objective aperture	有效物镜孔径
WE	working electrode	工作电极
WPOA	weak scattering object approximation	弱散射目标近似
XANES	X-ray absorption near edge structure	X射线吸收近边结构
XAS	X-ray absorption spectroscopy	X射线吸收谱
XEDS	X-ray energy-dispersive spectroscopy	X射线能量分散谱
XPS	X-ray photoelectron spectroscopy	X射线光电子谱
XRD	X-ray diffraction	X射线衍射