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3. ABBREVIATIONS

2,3,4,6-TeCP	2,3,4,6-tetrachlorophenol
2,3-DMP	2,3-dimethylpentane
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,5-TP	2-(2,4,5-trichlorophenoxy)propionic acid
2,4,6-TCP	2,4,6-trichlorophenol
2,4-D	2,4-dichlorophenoxyacetic acid
2,4-DCP	2,4-dichlorophenol
2,4-DMP	2,4-dimethylphenol
2-CP	2-chlorophenol
2-DNP	2-dinitrophenol
2-M-4,6-DNP	2-methyl-4,6-dinitrophenol
2-NP	2-nitrophenol
4-NP	4-nitrophenol
AA	amino acid
AAA	amino acid compositional analysis
AAS	atomic absorption spectrometry
ACN	acetonitrile
ADAM	9-anthryldiazomethane
ADC	analog-to-digital converter
AD-CSP	amylose <i>tris</i> -(3,5-dimethylphenylcarbamate) CSP
AE	alcohol ethoxylates
AEDA	aroma extract dilution analysis
AFM	atomic force microscopy
AGP	α_1 -acid glycoprotein

AMD	automated multiple development
AMW	acidic mine waters
ANN	artificial neural network
APCI	atmospheric pressure chemical ionization
APE	alkylphenol ethoxylates
API	atmospheric pressure ionization
AQC	6-aminoquinolyl- <i>N</i> -hydroxysuccinimidyl carbamate
ASE	accelerated solvent extraction
ASE	Archimedean screw effect
ASP	amnesic poisoning
ASPEC	automated SPE clean-up
ASTM	American Society for Testing and Materials
b.p.	boiling point
BE	benzoylecgonine
BF	batch factor
BF	Best Foods
BGE	background electrolyte
BOD	biological oxygen demand
BPR	back-pressure regulator
BSA	bovine serum albumin
BSTFA	<i>N,O</i> - <i>bis</i> -(trimethylsilyl)trifluoroacetamide
BTEX	benzene, toluene, ethylbenzene, xylene
BTX	benzene, toluene, xylene
C(GC) ²	comprehensive gas chromatography
c.m.c.	critical micellar concentration
CB	Contaminants Branch
CBH I	cellobiohydrolase I
CCC	countercurrent chromatography
CCDs	charged coupled devices
CCP	chiral coated phase
CD	cyclodextrin
CDCCC	centrifugal droplet countercurrent chromatography
CDR	chiral derivatization reagent
CE	capillary electrophoresis
CEC	capillary electrochromatography
CF-FAB	continuous flow – fast atom bombardment
CI	chemical ionization
CID	collision-induced dissociation
CLA	conjugated linoleic acid
CLD	chemiluminescence detector
CMA	chiral mobile-phase additive
CMP	chiral mobile phase
CMR	continuous membrane reactor
CoMFA	comparative molecular field analysis
CPC	coil planet centrifuges
CPF	co-current permeate flow
CPT	cone penetrometer
cSFC	supercritical fluid chromatography with a capillary column
CSP	chiral stationary phase
CTA	cellulose triacetate
CTAB	cetyltrimethylammonium bromide
CV	coefficient of variation
CXC	cation exchange chromatography
CZE	capillary zone electrophoresis
DA	domoic acid

DABITC	dimethylaminoazobenzene isothiocyanate
DABS	dimethylaminonaphthalene-5-sulfonyl
DAG	diacetonegluonic acid
DANS	1- <i>N</i> , <i>N'</i> -dimethylaminonaphthalene-5-sulfonyl
DB-5	5% poly(diphenyldimethylsiloxane)
DBT	dibenzothiophene(s)
DBV	divinylbenzene
DCCC	droplet countercurrent chromatography
DCTFA	1,2-dichlorotetrafluoroacetone
DEHPA	di(2-ethylhexyl)phosphoric acid
DETA	diethylenetriamine
DIA	deisopropylatrazine
DIC	diisopropylcarbodiimide
DIGE	difference gel electrophoresis
DMAPA	dimethylaminopropylamine
DMCS	dimethylchlorosilane
DME	α,ω -dicarboxylic acid methyl esters
DMOX	4,4-dimethyloxazoline
DNP	dinitrophenyl
DNPH	2,4-dinitrophenylhydrazine
DNPU	3,5-dinitrophenyl urethane
DP	degree of polymerization
DRI	differential refractive index
DRIFT	diffuse reflectance Fourier transform infrared
DSC	<i>N,N'</i> -disuccinimidylcarbonate
DSP	diarrhoeic poisoning
DTX	dinophysistoxins
ECD	electron-capture detector
ECF	ethyl chloroformate
ECL	equivalent chain length
ECN	equivalent carbon number
ED	electrodialysis
ED	extractive distillation
EDMA	ethylene glycol dimethacrylate
EDTA	ethylenediaminetetraacetic acid
ee	enantiomer excess
EG	ethylene glycol
EGA	ethylene glycol adipate
EHPA	mono-2-ethylhexyl ester
EI	electron ionization
ELCD	electrolytic conductivity detector
ELSD	evaporative light-scattering detector
EOF	electroosmotic flow
EPA	Environmental Protection Agency
ESCA	electron spectroscopy for chemical analysis
ESI	electrospray ionization
EtG	ethyl glucuronide
FAB	fast atom bombardment
FAEE	fatty acid ethyl ester
FAME	fatty acid methyl ester
FDA	Food and Drug Administration
FDNB	1-fluoro-2,4-dinitrobenzene
FFA	free fatty acid
FFPPC	forced flow PPC
FID	flame ionization detector

FMOc	fluoronlmethyl chloroformate
FPD	flame photometric detector
FTD	flame thermionic detector
FT-IR	Fourier transform infrared spectrometry
FT-Raman	Fourier transform Raman
GC	gas chromatography
GC-FTIR	gas chromatography – Fourier transform infrared spectrometry
GC-IRMS	gas chromatography – isotope ratio mass spectrometry
GC-MS	gas chromatography – mass spectrometry
GC-MS/MS	GC with coupled or tandem MS
GFAA	graphite furnace atomic absorption
GFC	gel filtration chromatography
GLP	Good Laboratory Practice
GPC	gel permeation chromatography
HAS	human serum albumin
HDC	hydrodynamic chromatography
HDEHP	di-(2-ethylhexyl)orthophosphoric acid
HETE _s	hydroxyeicosatetraenes
HETP	height equivalent to one theoretical plate
HFB	heptafluorobutyryl
HI	hydrophobic interaction
HIC	hydrophilic interaction chromatography
HIC-CXC	hydrophilic interaction – cation exchange chromatography
HMDS	hexamethyldisilazine
HOM	humic organic matter
HOMO	highest occupied molecular orbital
HPA	heteropolyacid
HPALC	high performance affinity liquid chromatography
HPIC	high performance ion chromatography
HPLC	high performance liquid chromatography
HPLC-CSP	HPLC-chiral stationary phases
HPTLC	high performance thin-layer chromatography
HRGC	high resolution gas chromatography
HS	humic substances
HSCCC	high speed countercurrent chromatography
HSES	hydrostatic equilibrium system
HS-GC	headspace-gas chromatography
HSSI	<i>N</i> -hydroxysulfosuccinimide
HS-SPME	headspace-solid-phase microextraction
HTGC	high temperature gas chromatography
HVS	high volume sampling
i.d.	internal diameter
IAM	immobilized artificial membrane
IBCF	isobutyl chloroformate
IBOC	<i>N</i> -isobutyloxycarbonyl
ICP-AES	inductively coupled plasma-atomic emission spectroscopy
ICP-MS	inductively coupled plasma-mass spectrometry
ICR	ion cyclotron resonance
IE	ion exchange
IEC	ion exchange chromatography
IEF	isoelectric focusing
IIR	ion interaction reagent
IP-TLC	ion pair-thin-layer chromatography
IR	infrared
IS	internal standard

ITD	ion trap detector/detection
IXISS	ion exchange isothermal supersaturation
JT	Joule-Thompson
L/B	length-to-breadth
LAS	linear alkylbenzenesulfonate
LC	liquid chromatography
LDH	lactic acid dehydrogenase
LD-OPLC	long-distance overpressured-layer chromatography
LEC	liquid exclusion chromatography
LFER	linear free-energy relationship
LLE	liquid-liquid extraction
LOD	limit of detection
LOX	liquid oxygen
LSC	liquid-solid chromatography
LSER	linear solvation energy relationship
LSIMS	liquid secondary ion mass spectrometry
LTB ₄	leukotriene B ₄
LUMO	lowest unoccupied molecular orbital
LVS	low volume sampling
MA	macrocyclic antibiotic
MAC	multistage air compressor
MAGIC	monodisperse aerosol generator interface for chromatography
MALDI	matrix-assisted laser desorption ionization
MALDI-MS	matrix-assisted laser desorption ionization-mass spectrometer
MASE	microwave-assisted solvent extraction
MBTH	3-methyl-2-benzothiazolinone hydrazone-HCl
MCF	methyl chloroformate
MCTA	microcrystalline cellulose triacetate
MDGC	multidimensional gas chromatography
MDMA	3,4-methylenedioxymethamphetamine
ME	methyl ester
MEKC	micellar electrokinetic chromatography
MF	microfiltration
MIBK	methylisobutylketone
MID	multiple ion detection
MIPs	molecular imprinted polymers
MLL	mean list length
ML-OPLC	multi-layer overpressured-layer chromatography
MP	mobile phase
MPA	mobile phase additive
MPA	3-mercaptopropionic acid
MPLC	medium pressure liquid chromatography
MS	mass spectrometry
MSD	mass selective detector/detection
MS-MS	tandem mass spectrometry
MSPD	matrix solid phase dispersion
MSTFA	<i>N</i> -methyl- <i>N</i> -trimethylsilyltrifluoroacetamide
MTBSTFA	<i>N</i> - <i>t</i> -butyldimethylsilyl- <i>N</i> -methyltrifluoroacetamide
MWD	molecular weight distribution
MWPC	multiwire proportional counters
NAC	<i>N</i> -acetyl-L-cysteine
NBP	4-(<i>p</i> -nitrobenzyl)pyridine
NCA	National Council on Alcoholism
NCI-GC-MS	negative ion chemical ionization-GC-MS
nd	not determined

NF	nanofiltration
NFM	<i>N</i> -formylmorpholine
NHYD	ninhydrin
NIR	near-infrared spectroscopy
NMP	<i>N</i> -methylpyrrolidone
NMR	nuclear magnetic resonance
NN	neural network
NP	normal phase
NPD	nitrogen-phosphorus detector
NQS	1,2-naphthoquinone-4-sulfonate
NRTL	nonrandom two liquids
NSAID	nonsteroidal anti-inflammatory drugs
o.d.	outer diameter
OA	okadaic acid
ODS	octadecylsilica
ODS-1	commercial octadecylsilica phase
OGCHI	ovoglycoprotein from chicken egg whites
OMCHI	chicken ovomucoid
OMCTS	octamethylcyclotetrasiloxane
OMTKY	turkey ovomucoid
OPA/MCE	<i>o</i> -phthalaldehyde/ β -mercaptoethanol
O-PFBO	<i>O</i> -pentafluorobenzoyloxime
OPLC	overpressured-layer liquid chromatography
OPTLC	overpressured TLC
OV-225	commercial phase
oxo-ETEs	oxo-eicosatetraene
P & T	purge-and-trap
PA	photoacoustic
PA	polyacrylate
PAD	pulsed amphoteric detector/detection
PAH	polyaromatic hydrocarbons
PAR	4-(2-pyridylazo)resorcinol
PAS	photoacoustic spectroscopy
PB	particle beam
PCA	principal component analysis
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo- <i>p</i> -dioxin
PCDF	polychlorinated dibenzofuran
PCP	pentachlorophenol
PDB	Pee Dee Belimnite
PDCA	pyridine-2,6-dicarboxylate
PDMS	poly(dimethylsiloxane)
PED	pulsed electrochemical detection
PEEK	polyetheretherketone
PEG	poly(ethylene glycol)
PEI	poly(ethyleneimine)
PEO	poly(ethylene oxide)
PETRA	pentaerythritol triacrylate
PFB	pentafluorobenzyl
PFBBr	pentafluorobenzyl bromide
PFBOA	pentafluorobenzoyloxime
PFP	pentafluoropropionyl
PFPH	pentafluorophenylhydrazine
PGC	porous graphitic carbon
PGM	platinum group metals

PHDC	packed column hydrodynamic chromatography
PLOT	porous-layer open-tubular
PLS	partial least squares
PMMA	poly(methyl methacrylate)
PNBX	potassium <i>n</i> -butylxanthate
PNP	purine nucleoside phosphorylase
PPC	preparative planar thin-layer chromatography
PPO	2,5-diphenyloxazole
PS	poly(styrene)
PSD	particle size distribution
PS-DVB	poly(styrene-divinylbenzene)
PSFC	packed-column supercritical fluid chromatography
PSP	paralytic poisoning
PTFE	poly(tetrafluoroethylene)
PTH	phenylthiohydantoin
PV	pervaporation
QSAR	quantitative structure-activity relationship
QSERR	quantitative structure enantioselective retention relationship
QSRR	quantitative structure-retention relationship
R/D	reflux-to-overhead ratio
RI	refractive index
RIA	radioimmunoassay
RLCCC	rotation locular countercurrent chromatography
RMM	relative molar mass
RO	reverse osmosis
RP	reversed-phase
RPC	reversed-phase chromatography
RS	Raman scattering
RSD	relative standard deviation
S/F	solvent-to-feed ratio
S/N	signal-to-noise ratio
SAC	strong acid cation
SARA	saturates, aromatics, resins and asphaltenes
SB/CD	short bed/continuous development
SBC	strong base anion
SBF	separation by flow
SCA	synthetic carrier ampholyte
SCOT	support-coated open-tubular
SD	standard deviation
SDE	simultaneous distillation-extraction
SDGlu	<i>N</i> -dodecanoyl-L-glutamate
SDS	sodium dodecyl sulfate
SDS-PAGE	sodium dodecyl sulfate-polyacrylamide gel electrophoresis
SDVal	sodium <i>N</i> -dodecanoyl-L-valinate
SDVB	styrene-divinylbenzene
SEC	size exclusion chromatography
SERRS	surface-enhanced resonance Raman scattering
SERS	surface-enhanced Raman scattering
SF	solvent front
SF ₆	sulfur hexafluoride
SFC	supercritical fluid chromatography
SFE	supercritical fluid extraction
SIM	selected ion monitoring
SIM	single ion monitoring
SMB	simulated moving bed

SN	separation number
SP	stationary phase
SPE	solid-phase extraction
SPM	simultaneous pyrolysis/methylation
SPME	solid-phase microextraction
SRB	sulfate-reducing bacteria
SS	supersaturated solution
STC	sodium taurocholate
STDC	sodium taurodeoxycholate
STX	saxitoxin
TA	time-to-amplitude
TAA	tetraalkylammonium
TAB	<i>N</i> -trifluoroacetyl- <i>n</i> -butyl ester
TBDMS	<i>t</i> -butyldimethylsilyl
TCD	thermal conductivity detector
TDS	total dissolved solids
TEA	thermal energy analyser
TEAA	triethylammonium acetate
TEAP	triethylammonium phosphate
TEG	triethylene glycol
TEPA	tetraethylenepentamine
TFA	trifluoroacetyl/trifluoroacetic acid
TGA	thermogravimetric analyser
THBC	1,2,3,4-tetrahydro- β -carboline
THCA	11-nor- Δ^9 -tetrahydrocannabinol-9-carboxylic acid
THF	tetrahydrofuran
TIQ	1,2,3,4-tetrahydroisoquinoline
TLC	thin-layer chromatography
TLC-MS	thin-layer chromatography-mass spectrometry
TLRC	thin-layer radiochromatography
TLV	threshold limit value
TMAH	tetramethylammonium hydroxide
TMCS	trimethylchlorosilane
TPMA	trimethylphenylammonium hydroxide
TMS	trimethylsilyl
TOC	total organic carbon
TOEDA	tetraoctylethylenediamine
TRIM	trimethylolpropane trimethacrylate
TSI	thermospray ionization
TTF	tetrathiafulvalene
UF	ultrafiltration
UHP	ultrahigh purity
UNIQUEAC	universal quasichemical
UrdPase	uridine phosphorylase
UTP	uniform transmembrane pressure
UV/Vis	ultraviolet-visible
V _C	total column capacity
VFA	volatile fatty acids
VLDL	very low-density lipoproteins
VLE	vapour-liquid equilibrium
VOCs	volatile organic chemicals
VPO	vapour pressure osmometry
V _R	retention volume of the solute
V _{SF}	retention volume of solvent front
WAC	weak acid cation

WBA	weak base anion
WCOT	wall-coated open-tubular
WPC	whey protein concentrates
XE-60	commercial phase
XRF	X-ray fluorescence
ZDDP	zinc dialkyldithiophosphate
β -CD	β -cyclodextrin

4. ANALYTICAL CHIRAL SEPARATION METHODS (IUPAC RECOMMENDATIONS 1997)

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Abstract

In recent years there has been considerable interest in the synthesis and separation of enantiomers of organic compounds especially because of their importance in the biochemistry and pharmaceutical industry. Frequently the methods used for the separations, for monitoring the progress of an asymmetric synthesis or optical purity of the products are chromatographic with either liquids, gases, or supercritical fluids as the mobile phase. More recently capillary electrophoresis has been added as an analytical chiral separation method.

These applications have led to a number of terms and expressions in addition to those commonly used or recently recommended for the chemistry and physical properties of chiral compounds. This Nomenclature provides the descriptions and definitions for additional terms particularly related to analytical separation methods, and to the formation and enantiomeric purity of chiral products

Introduction

Enantiomers are two chemically identical molecular species which differ from each other as non-superposable mirror images. The most simple and vivid model for enantiomeric structures is the two hands, left and right. Enantiomers, in addition to diastereomers and *cis-trans*-isomers, are thus a special case of stereoisomers.

The chirality (handedness) of enantiomeric molecules is caused by the presence of one or more chirality elements (chirality axis, chirality plane, or chirality centre, e.g. asymmetric carbon atom) in their structure. The chirality sense and optical activity of the enantiomers are determined by their absolute configuration, i.e. the spatial arrangement of the atoms in the molecule. In contrast to their conformation, the configuration of enantiomers cannot be changed without a change in the connectivity of constituent atoms. Designation of the configuration of enantiomers should be made in accordance with the Cahn-Ingold-Prelog *R, S*-system. The Δ - Λ designations for enantiomers of octahedral complexes and the *D, L* Fischer-Rosanoff designations for amino acids and sugars are also in use.

Conventional chemical synthesis, in contrast to asymmetric synthesis, deals mostly with the transformations of achiral compounds. If these reactions result in the formation of a chirality element in the molecule, the reaction product appears to be an equivalent mixture of a pair of enantiomers, a racemate, which is optically inactive. Racemates are also formed through racemisation of chiral compounds. Racemates crystallize in the form of a racemic compound or, less frequently, as a conglomerate.

Separation of the enantiomers comprising the racemate, i.e. the resolution of the racemate, is a common problem in stereochemical research as well as in the preparation of biologically active compounds, in particular, drugs. The problem is that in contrast to diastereomers and all the other types of isomeric species,