

SAMS: Speaking with Acronyms in Mass Spectrometry

Kenneth L. Busch

Perusing this year's Pittsburgh Conference schedule, the intrepid mass spectrometrists can plan to attend talks on QMS using MEMS, FT-ICR using SWIFT, LS-APGD mass spectrometry, or perhaps even a talk to hear about the latest practices in PS-TOFMS. This conglomeration of acronyms and abbreviations appearing in the titles of the scheduled presentations reflects the diversity of modern analytical mass spectrometry (MS), but also underscores the tendency of scientists to engage in "speaking with acronyms," often to the detriment of understanding of those new to the field, and sometimes to the confusion of those of us who have been involved with it forever. Manufacturers engage in the coining of acronyms (and trademarks) as well, to describe their particular approach or instrumentation. Our exemplar spectrometrists need only wander through the aisles of the Pittsburgh Conference, examining the displays and the literature, to confirm the proliferation of acronyms, and not only within the field of MS, but in analytical chemistry and science in general. For instance, nuclear magnetic spectroscopy has a selection of multidimensional experiments described by acronyms of clever construction (NOESY and TOSS as examples).

SAMS is the topic of the current column. SAMS is, of course, the acronym for Speaking with Acronyms in Mass Spectrometry (or it could be Surface Automated Meteorological System, or Software Acquisition Management Seminar, or any of the 15 other definitions returned from a web search for the meaning of the acronym). To search for meanings of acronyms and abbreviations, use acronym look-up sites on the web (1–3) and commercial products (4) that define acronyms as they are typed into a text document. The web contains numerous lists that define acronyms and abbreviations in specific fields; however, only one web site was found to contain a very short list specific to MS (5). To remedy this perceived deficiency, this column contains an extensive list of MS acronyms and abbreviations. No claim of completeness for the list is made, as each year's professional meetings bring new acronyms to the fore, and each year's advances render older acronyms obsolete. Symbols used in equations are not specifically included in this list, but many common symbols that are not acronyms or abbreviations (but find themselves incorporated into them) are included. Likewise, all combinations of acronyms are not separately included. The list contains a few common chemical abbreviations that recur in MS publications, but the number of

such has been purposefully minimized. Finally, different professional journals accept different acronyms and abbreviations for publication, and these also change with time and editors.

Acronyms have scientific meaning and history behind them, and often a specific personal story related to their derivation. For example, SIMS (organic SIMS or molecular SIMS, to be specific) became LSIMS when FAB became popular. CID and CAD appeared in concurrent common use, fueling discussions of some of the mechanistic details of ion activation and subsequent fragmentation. MALDI-TOF rolls so easily off the tongue that no acronymic competitor has appeared. The synergistic capabilities of hyphenated methods such as GC/MS and LC/MS are a common teaching topic. The literal student searches for the hyphen, and the prescient professor avoids the lecture on virgulate methods. The term "hyphenated method" derives from the authoritative article by Tomas Hirschfeld (6). Modern usage states that a description of an instrument uses hyphens, as in a gas chromatograph connected to a mass spectrometer (GC-MS). The abbreviation that describes the method uses the slash (GC/MS). That is, GC-MS is an instrument made up of a gas chromatograph linked to a mass spectrometer, while GC/MS is the method of gas chromatography/mass spectrometry.



Kenneth L. Busch has (on rare occasions) participated in the process of GNADOTH (Generation of New Acronyms at the Drop of the Hat). Fortunately, few people have read his Ph.D. dissertation within which this transgression occurred. Worse still, since then he has transformed nouns into verbs ("What happens when you CID the ion?"). If he has a saving grace, it is that he knows the origin of the name ZAB for a commercial series of high-resolution mass spectrometers, and resisted using FAB ZAB LAB for a business card address in younger days. If you have a favorite acronym that is not included here in the list, e-mail him at buschken@hotmail.com.

List of Acronyms and Abbreviations

Some acronyms and abbreviations in common use are protected trademarks. Inclusion in the following list is explicitly not an endorsement for use. Note that some acronyms and abbreviations have multiple meanings.

A

A⁻ — Anion

ADC — Analog-to-digital converter
 ADO — Average dipole orientation
 AE — Appearance energy
 AEI — Associated Electric Industries
 AGHIS — All-glass-heated-inlet system
 AMS — Accelerator mass spectrometry
 amu — Atomic mass unit
 AN — Auger neutralization
 ANP — 2-Amino-5-nitropyridine, a MALDI matrix

ANZSMS — Australia and New Zealand Society for Mass Spectrometry
 AP — Appearance potential
 APCI — Atmospheric-pressure chemical ionization
 API — Atmospheric-pressure ionization
 ARMS — Angle-resolved mass spectrometry
 ASGDIMS — Atmospheric-sampling glow discharge ionization mass spectrometry
 ASMS — American Society for Mass Spectrometry
 ASTM — American Society for the Testing of Materials
 AVS — Accelerating-voltage scan; American Vacuum Society

B

b — Impact parameter
 B — Magnetic sector mass analyzer; magnetic field; magnetic sector field strength or flux density
 BAT — Best-anode temperature
 B/E — Linked scan for product ions
 B²E — Linked scan for parent ions
 BEoQ — A reverse geometry sector instrument followed by an octupole collision cell followed by a quadrupole mass filter
 BEqQ — A reverse geometry sector instrument followed by a collision (rf-only) quadrupole followed by a quadrupole mass filter
 BEMS — *Biomedical and Environmental Mass Spectrometry*
 BET — Best emitter temperature
 BMS — *Biomedical Mass Spectrometry; Biological Mass Spectrometry*

C

C⁺ — Cation
 CA — Collisional activation
 CAD — Collisionally activated decomposition
 CDEM — Continuous-dynode electron multiplier
 CE — Charge exchange; capillary electrophoresis
 CEC — Consolidated Electric Corp.
 CEM — Channel electron multiplier
 CEMA — Channel electron-multiplier array
 cfTM — Conflat
 CFFAB — Continuous-flow fast atom bombardment
 CFP — Continuous flow probe

CI — Chemical ionization
 CID — Collision-induced dissociation
 CIDI — Collisionally induced dissociative ionization
 CIT — Cylindrical ion trap
 CM — Center-of-mass
 COM — Center-of-mass
 CREMS — Charge-reduction electrospray mass spectrometry
 CRIMS — Chemical reaction interface mass spectrometry
 CS — Charge stripping
 CX — Charge exchange
 CZE/MS — Capillary zone electrophoresis/mass spectrometry

D

D — Disproportionation factor; deuterium
 Da — Dalton
 DAC — Digital-to-analog converter
 DADI — Direct analysis of daughter ions
 DBE — Double-bond equivalent
 DCI — Desorption (or direct) chemical ionization
 DCT — Double charge transfer
 DE — Delayed extraction (as in time-of-flight mass analysis)
 DEI — Desorption (or direct) electron ionization
 DFTPP — Decafluorotriphenylphosphine
 DHB — 2,5-Dihydroxybenzoic acid, a MALDI matrix
 DI — Desorption ionization
 DIN — Direct injection nebulizer
 DIP — Direct-insertion probe
 DLI — Direct liquid introduction
 DLV — Direct laser vaporization
 DP — Direct probe; diffusion pump
 DS — Data system
 DTMS — Drift tube ion mobility spectrometry

E

E — Energy; electric sector mass analyzer; electric sector voltage
 EA — Electron affinity
 EAD — Electron avalanche desorption
 ECD — Electron-capture dissociation
 ECID — Electron-capture-induced dissociation
 ECMS — Electron-capture mass spectrometry
 ECNCI — Electron-capture negative chemical ionization
 ECNI — Electron-capture negative ionization
 ECP — Emitter-current programmer

EDD — Energy distribution difference
 EE — Even-electron ion
 EHI — Electrohydrodynamic ionization
 EI — Electron ionization; electron impact
 EIEIO — Electron-induced excitation of ions from organics
 EIS — External ion source
 EJMS — *European Journal for Mass Spectrometry*
 EM — Electron multiplier

EMP — Electron multiplier
 EOID — Electrooptical ion detector
 ERMS — Energy-resolved mass spectrometry
 ES — Electrospray
 ESA — Electrostatic analyzer
 ESD — Electron-stimulated desorption
 ESI — Electrospray ionization
 ESMS — Electrospray ionization mass spectrometry
 ESP — Electrospray ionization

ESPI — Electrospray ionization
esu — Electrostatic unit
ETV — Electrothermal vaporization
eV — Electron volt

F

FA — Flowing afterglow
FAB — Fast-atom bombardment
FAIMS — High-field asymmetric wave-
form ion mobility spectrometry

FC — Faraday cup
FD — Field desorption
FFID — Fission-fragment induced
desorption
FFR — Field-free region
FI — Field ionization
FIB — Fast-ion bombardment;
focused ion beam
FIK — Field-ionization kinetics

FIMS — Field-ionization mass
spectrometry
FIS — Field ion spectrometry
FNB — Fast neutral beam
FPD — Focal plane detector
FT-ICR — Fourier-transform ion
cyclotron resonance
FTMS — Fourier-transform mass
spectrometry
FT/TOF — Fourier-transform time-of-
flight mass spectrometry
FWHH — Full-width at half-height
FWHM — Full-width at half maximum

G

G — Multiplier gain
GC — Gas chromatography
GC/MS — Gas chromatography/mass
spectrometry
GD/MS — Glow discharge mass
spectrometry
GIANT — Gas-phase ion and neutral
thermochemistry
GLP — Good laboratory practices

H

4-HBSA — 4-Hydroxybenzenesulfonic
acid, an LSIMS/FAB matrix
HCD — Heated capillary dissociation
HCP — Hollow cathode plume
2-HEDS — 2-Hydroxyethyl disulfide, an
LSIMS/FAB matrix
HPA — 3-Hydroxypicolinic acid, a
MALDI matrix
2-HPEA — 2-Hydroxyphenethyl
alcohol, an LSIMS/FAB matrix
HRMS — High-resolution mass
spectrometry
HSI — Hyperthermal surface ionization
HT — High tension, which is a Britishism
for high voltage

I

IC — Ion chromatography
ICDR — Ion cyclotron double resonance
IC/MS — Ion chromatography/mass
spectrometry
ICPMS — Inductively coupled plasma
mass spectrometry
ICR — Ion cyclotron resonance
IDMS — Isotope dilution mass
spectrometry
IE — Ionization energy, ionizing energy;
ion evaporation
IJMSIP — *International Journal of Mass
Spectrometry and Ion Physics* (Volumes
1–62); *International Journal of Mass*

Spectrometry and Ion Processes (after Volume 62)

IKE(S) — Ion kinetic energy (spectrometry)

IMS — Ion mobility spectrometry

IP — Ionization potential

IPD — Ion-photon detector

IRMS — Isotope ratio mass spectrometry

ISD — In-source decay

ISP™ — Ionspray

ISR — Ion/surface reaction

ITD™ — Ion trap detector (Finnigan MAT)

ITMS — Ion trap mass spectrometry

ITP/MS — Isotacopheresis/mass spectrometry

IUPAC — International Union of Pure and Applied Chemistry

J

JASMS — *Journal of the American Society for Mass Spectrometry*

JMS — *Journal of Mass Spectrometry*

K

K — Kelvin

kDa — Kilodalton

KERD — Kinetic-energy-release distribution

K⁺IDS — Potassium ion desorption spectrometry

KNN — K-nearest neighbor

L

L — Length of flight tube

LAMMA™ — Laser microprobe mass analyzer

LBO — Light beam oscillograph

LC/MS — Liquid chromatography/mass spectrometry

LD — Laser desorption

LDI — Laser desorption ionization

LDLP — Laser desorption/laser photoionization

LI — Liquid ionization

LIMA™ — Laser ionization mass analyzer; Laser ion microprobe analyzer

LMMS — Laser microprobe mass spectrometer

LMS — Laser mass spectrometry

LOD — Limit of detection

LOQ — Limit of quantitation

LRB — Laboratory reagent blank

LSIMS — Liquid matrix secondary ion mass spectrometry

LTOF — Laser time-of-flight; Linear time-of-flight

LV/EI — Low voltage electron ionization (sometimes LV-EI)

M

u — Unified atomic mass unit ($\frac{1}{12}$ of the mass of ¹²C), now replaced by dalton

m — Mass of the ion in units of u

MAB — Metastable atom bombardment

MAGIC — Monodisperse aerosol generator interface for chromatography

MALD — Matrix-assisted laser desorption
MALDI — Matrix-assisted laser desorption ionization (also maLDI)

MAPS — Method for analyzing patterns in spectra

MB — Molecular beam

MBMS — Molecular beam mass spectrometry

MCA — Multichannel analyzer or multichannel acquisition

MCI — Massive cluster impact
 MCP — Microchannel plate, multichannel plate
 MCPD — Microchannel plate detector
 MD/MS — Microdialysis mass spectrometry
 MDL — Method detection limit
 MI — Metastable ion
 MID — Multiple ion detection
 MIKE(S) — Mass-analyzed ion kinetic energy (spectrometry)

MIM — Multiple-ion monitoring
 MIMS — Membrane introduction mass spectrometry
 MIP — Microwave-induced plasma
 mNBA — *m*-Nitrobenzyl alcohol
 MNDO — Modified neglect of differential overlap
 MO — Molecular orbital
 MPD — Multiphoton dissociation
 MPI — Multiphoton ionization

MPM — Multiple-peak monitoring
 MQDT — Multichannel quantum-defect theory
 MRM — Multiple-reaction monitoring
 MS — Mass spectrometer; mass spectrometry; mass spectrum
 MS^{*n*} — If *n* = 2, MS/MS. If *n* = 3, MS/MS/MS. Repeat as necessary.
 MSD™ — Mass selective detector
 MSDC — Mass Spectrometry Data Center
 MSM — Multiple-scattering method
 MSR — *Mass Spectrometry Reviews*
 MS/MS — Mass spectrometry/mass spectrometry
 MSSS — Mass spectral search system
 MW — Molecular weight
 Mwt — Molecular weight

N

N — Neutral molecule or species
 nanoES — Nanoelectrospray
 NBA — *m*-Nitrobenzyl alcohol
 NCI — Negative-ion chemical ionization
 NICI — Negative-ion chemical ionization
 NOBA — *m*-Nitrobenzyl alcohol
⁺NR⁺ — Neutralization reionization; a positive ion is neutralized and then reionized
 NRMS — Neutralization reionization mass spectrometry

O

oa — Orthogonal acceleration (usually lower case)
 OE — Odd-electron ion
 OMS — *Organic Mass Spectrometry*

P

PA — Proton affinity
 PAD — Postacceleration detector
 PAI — Postablation ionization
 PBM — Probability-based matching
 PBMS — Particle-beam mass spectrometry
 PCI — Positive-ion chemical ionization
 PD — Plasma desorption; photodissociation
 PDMS — Plasma-desorption mass spectrometry
 PEPICO — Photoelectron-photoion coincidence spectroscopy
 PES — Photoelectron spectroscopy
 PFK — Perfluorokerosene
 PFTBA — Perfluorotributylamine
 PID — Particle-induced desorption; photon-induced dissociation

PIE — Photoionization efficiency
 PIPECO — Photoion-photoelectron co-
 incidence spectroscopy
 PMS — Parallel mass spectrometry
 PPINICI™ — Pulsed positive ion nega-
 tive ion chemical ionization
 PSD — Post-source decay
 PSPF — Post-source pulse focusing
 PSI — Pulsed sample introduction
 PyMS — Pyrolysis mass spectrometry

Q

q — Quadrupole device used in rf-only
 mode as a collision cell
 qCID — Collision-induced dissociation
 accomplished within an rf-only
 quadrupole
 Q — Quadrupole mass filter
 Q — Reaction endothermicity
 QCPE — Quantum Chemistry Program
 Exchange
 QET — Quasiequilibrium theory
 QFTMS — Quadrupole Fourier trans-
 form mass spectrometry
 QIT — Quadrupole ion trap
 QUISTOR — Quadrupole ion storage trap

R

r — Radius of electric or magnetic
 sector; rearrangement reaction
 RA — Relative abundance
 RDA — Retro Diels-Alder reaction
 rdbe — Rings plus double bonds equiva-
 lent
 RE — Recombination energy
 REC — Resonance electron capture
 REMPI — Resonance-enhanced multi-
 photon ionization
 reTOF — Reflectron time-of-flight mass
 spectrometer
 rf — Radio frequency; response factors
 RGA — Residual gas analyzer
 RI — Relative intensity
 RIMS — Resonance-ionization mass
 spectrometry
 RMM — Relative molecular mass
 RN — Resonance neutralization
 R2PI — Resonant 2 photon ionization
 RP — Resolving power
 RPD — Retarding potential difference
 RRKM — Rice, Ramsberger, Kassel, and
 Marcus theory
 rTOF — Reflectron time-of-flight

S

SA — Sinapinic acid (a matrix used in
 laser desorption)

SDM — Selected-decomposition
 monitoring
 SEAC — Surface-enhanced affinity capture
 SEND — Surface-enhanced neat
 desorption
 SFC/MS — Supercritical fluid
 chromatography/mass spectrometry
 SI — Surface ionization
 SID — Surface-induced dissociation
 SIFDT — Selected-ion flow drift tube

SIFT — Selected-ion flow tube
 SIM — Selected-ion monitoring
 SIMBROC — Simulated background and
 reduction/oxidation calculations
 SIMS — Secondary-ion mass
 spectrometry
 SIN — Surface-induced neutralization
 SIOMS — Surface ionization organic
 mass spectrometry
 SIR — Selected-ion recording

SMB — Supersonic molecular beam
 SMOKE — Stored modulation of kinetic energy
 SRBC — Simulated reduction and background calculations
 SRM — Selected-reaction monitoring; standard reference material
 SSI — Sonic spray interface
 SSMS — Spark source mass spectrometry
 STIRS — Self-training interpretive and retrieval system
 STMT — Stieltjes-Tchebycheff moment theory
 SWIFT™ — Stored-waveform inverse Fourier transform
 SWIM — Stored waveform ion modulation

T

t — Ion flight time, time
 T — Tesla; kinetic energy release value
 TAC — Time-to-amplitude converter
 TAMS — Tandem accelerator mass spectrometry
 TDC — Time-to-digital converter

TEL — Translational energy loss
 TEPsICO — Threshold electron photoion secondary ion coincidence
 TES — Translational energy spectroscopy
 TGA/MS — Thermogravimetric analysis/mass spectrometry
 TG/GC/MS — Thermogravimetry/gas chromatography/mass spectrometry
 TI — Thermal ionization
 TIC — Total ion current
 TID — Trapped ion detector; thermally induced dissociation
 TIMS — Thermal ionization mass spectrometry
 TLC/MS — Thin layer chromatography/mass spectrometry
 TLF — Time-lag focusing
 TMS — Trimethylsilyl-; tetramethylsilyl-; tandem mass spectrometry; thermospray mass spectrometry
 TOF — Time-of-flight
 TOFMS — Time-of-flight mass spectrometry
 TQMS — Triple-quadrupole mass spectrometry

TRPD — Time-resolved photodissociation
 TSP — Thermospray
 TSQ™ — Triple-stage quadrupole mass spectrometer
 TSQ™ — Triple-stage quadrupole

U

uL²MS — Microprobe laser desorption/laser ionization mass spectrometry (The author nominates this abbreviation as the most confusing one yet to appear in print.)
 UV/LD — Ultraviolet laser desorption

V

v — Ion velocity
 V — Accelerating voltage; accelerating voltage scan
 VG™ — Vacuum Generators, a company
 VTST — Variational transition state theory

W

W — Wien filter

Z

z — The charge state of the ion in units of the electronic charge

References

1. www.ucc.ie/info/net/acronyms/acro.html
2. www.acronymfinder.com
3. www.acronymsearch.com
4. Acro Wizard is an example of such a commercial product.
5. http://web.mit.edu/speclab/www/ms_acro.html
6. T. Hirschfeld, *Anal. Chem.* **52**, 297A (1980).
7. K. Busch, *Spectroscopy* **16**(11), 28–31 (2001). ■

Correction: Several readers pointed out an error that I embarrassingly allowed to appear in the previous Mass Spectrometry Forum column, "Units in Mass Spectrometry" (7). The correct relationship between coulombs and amperes is $1\text{ C} = 1\text{ A}\cdot\text{s}$. Thanks to the keen readers who pointed out the error. — Ken Busch

