XII Acronyms and Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
1-D, 1D	One-dimensional
2-D, 2D	Two-dimensional
3-D, 3D	Three-dimensional
1Q	First quarter of the fiscal year
2Q	Second quarter of the fiscal year
3Q	Third quarter of the fiscal year
4Q	Fourth quarter of the fiscal year
6F	Hexafluorinated (biphenol A) sulfonated poly(arylene ether sulfone)
Ω-cm^2	Ohm-square centimeter
A	Ampere, amp
Å	Angstrom
AB	Ammonia borane
ABMS	Agent-based modeling and simulation
ABPBI	Poly(2,5-benzimidazole)
A/cm^2	Amps per square centimeter
AC	Alternating current
AC	Activated carbon
A/C	Anode/cathode
ACR	Autothermal cyclic reforming
ACS	American Chemical Society
ACT	Alameda Contra Costa Transit
A-D	AC-DC (alternating current - direct current), used to describe a converter
ADG	Anaerobic digester gas
ADM	Archer Daniels Midland Company
ADRY	Acceleration of the deactivation reactions of the water-splitting system Y
AECP	Association of Energy Conservation Professionals
AEESM	Advanced electrical energy storage module
AEET	Alternative energy education technology
AEM	Analytical electron microscopy
AEO2003	Annual Energy Outlook 2003
AER	Absorption-enhanced reforming
AES	Auger electron spectroscopy
AFB	Air Force Base
AFM	Atomic force microscopy
AFRL	Air Force Research Laboratory
AFV	Alternative fuel vehicle
Ag	Silver
AgCl	Silver chloride
AIChE	American Institute of Chemical Engineers
AIM	Application interface module
AIP	Analytical Interatomic Potential (computer model)
AIP	American Institute of Physics
AirCred	Air Quality Credits calculation software tool developed by ANL
Al	Aluminum
$AlCl_3$	Aluminum chloride
AlH_3	Aluminum hydride; alane
Al_2O_3	Aluminum oxide
AM1	Austin Model 1
AM 1.5	Air Mass 1.5 solar illumination
AMRL	Active magnetic regenerative liquefier
AMRR	Active magnetic regenerative refrigerator
ANL	Argonne National Laboratory
ANS	American Nuclear Society
ANSI	American National Standards Institute
APCI, APCi	Air Products and Chemicals, Inc.
API	American Petroleum Institute
APR	Aqueous-phase reforming
APS	Arizona Public Service
APS	American Physical Society
APU	Auxiliary power unit
Ar	Argon
As	Arsenic
ASCM	Automotive System Cost Model, a spreadsheet model developed to estimate the costs of advanced technology vehicles and their components based on PSAT model outputs
ASES	American Solar Energy Society
a-Si	Amorphous silicon
ASIC	Application-specific integrated circuit
a-SiGe	Amorphous silicon germanium
ASM	American Society of Metals
ASM	ASM International - the Materials Information Society

ASME	American Society of Mechanical Engineers
ASMSS	Anode side membrane support structure
ASPDS	Automated spray pyrolysis deposition system
ASR	Area-specific resistance
ASTM	American Society for Testing and Materials
at%, at.%	Atomic percent
ATCC	American Type Culture Collection
ATG	Adenine,Thymine,Guanine, the 3 base combinations that indicate the first translatable amino acid on the DNA molecule
atm	Atmosphere
ATMI	Advanced Technical Materials Incorporated
ATP	Adenosine triphosphate
ATR	Autothermal reformer; autothermal reforming
Au	Gold
AuS	Gold sulfide
Avg	Average
B	Boron
Ba	Barium
barg	Bar gauge
bcc	Body-centered cubic
Be	Beryllium
BES	Basic Energy Sciences office within the DOE Office of Science
BET	Bruner, Emmett and Teller surface area analysis method
BH_4	Borohydride
Bi	Bismuth
BN	Boron nitride
BNH	Dehydrogenated ammonia-borane
BNL	Brookhaven National Laboratory
B_2O_3	Boron oxide; diboron trioxide
BOL	Beginning of life
BOP, BoP	Balance-of-plant
bp	Base pair
BP	British Petroleum
BPM	Brushless permanent magnet
BPPPO	Biphenol-based phenyl phosphine oxide
BPPPO-35	Biphenol-based phenyl phosphine oxide copolymer, 35% molar fraction of disulfonic acid unit (35% level of sulfonation)
BPS	Ballard Power Systems
BPSH	Biphenyl sulfone H form
BPSH-30	Biphenyl sulfone H form, 30% molar fraction of disulfonic acid unit (30% level of sulfonation)
Br	Bromine
Br_2	Diatomic bromine
BSE	Back scattered electron
BTD	Best to date
BTU, Btu	British thermal unit(s)
C	Carbon
C	Couloumb
Ca	Calcium
$CaBr_2$	Calcium bromide
C&C	City and County of Honolulu
$CaCO_3$	Calcium carbonate
CAD	Computer-aided design
CAE	Computer-aided engineering
CAN	Controller area network
CANMET	Canada Center for Mineral and Energy Technology
CaO	Calcium oxide
CaS	Calcium sulfide
CATA	Centre Area Transit Authority
CbHS	Carbon-based Hydrogen Storage
CBS	Casa Bonita strain
cc	Cubic centimeter(s)
CCF	Complex coolant fluid
cc/g cat/hr	Cubic centimeter(s) per gram catalyst per hour
CCHSS	Complex Compound Hydrogen Storage System
CCM	Catalyst-coated membrane
Cd	Cadmium
CD	Compact disk
CDC	Carbide-derived carbon
CdS	Cadmium sulfide
cDNA	Complementary DNA
CDO	Code development organization
Ce	Cerium
CEA	Commissariat a Energie Atomique
CEC	California Energy Commission
CEM	Compressor/Expander/Motor
CeO_2	Ceric oxide
Cermet	Combination of ceramic and metal
CERT	Committee on Energy Research and Technology
CESI	Catalytica Energy Systems, Inc.
CF	Carbon fiber
CF	Constant flow

CFD	Computational fluid dynamics
cfm	Cubic feet per minute
CGA	Compressed Gas Association
CGO	Cerium gadolinium oxide
CH_2	Compressed hydrogen gas
CH_4	Methane
C_2H_4	Ethylene
C_2H_6	Ethane
C_3H_8	Propane
CHARM	Cost-effective High-efficiency Advanced Reforming Module
CHES	Corral Hollow Experimental Station
Chl	Chlorophyll
CHP	Combined heat and power
CI	Compression ignition
CIGS	Copper-indium-gallium-diselenide
CIS	CuInSe (alloy of copper, indium, and selenium)
Cl	Chlorine
CLV	City of Las Vegas
cm	Centimeter
cm^2	Square centimeter
CMDR	Coupled magnetization-demagnetization refrigerant
CMS	Carbon molecular sieve
CMU	Carnegie Mellon University
CNG	Compressed natural gas
CNP	Combinatorial nanoparticle
CNT	Carbon nanotube
CO	Carbon monoxide
Co	Cobalt
CO_2	Carbon dioxide
CoE	Center of Excellence
COF_2	Carbonylfluoride
COS	Carbon oxysulfide; carbonyl sulfide
CoTMPP	Cobalt tetramethoxyphenyl porphyrin
CoTPP	Cobalt tetraphenyl porphyrin
COx	Oxides of carbon
CPC	Compound parabolic concentrator
CpI	Clostridium pasteurianum [FeFe]-hydrogenase
c.p.s.	Counts per second
CPSS	Combinatorial powder synthesis system
CP-Ti	Commercially pure titanium
Cr	Chromium
CRBJT	Combined reverse-Brayton Joule-Thompson
CS	Chemically stabilized
CS	Ceramic support
Cs	Cesium
CSA	Canadian Standards Association
CSA	Cell stack assembly
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CSMP	Cabot Superior MicroPowders
CSR	Catalytic steam reforming
CSTT	Codes and Standards Tech Team
CTE	Coefficient of thermal expansion
CTO	Conductive transparent oxide
CTV	Chevron Technology Ventures LLC
Cu	Copper
CU	University of Colorado
cu.yd.	Cubic yard(s)
CuO	Cupric oxide, copper(II) oxide
Cu_2O	Cuprous oxide
CUTE	Clean Urban Transport for Europe
CV	Cyclic voltammatry; cyclic voltammogram
CVD	Chemical vapor deposition
CVS	Chemical vapor synthesis
CWRU	Case Western Reserve University
CY	Calendar year
CZO	Ceria-zirconia
d	Day(s)
D_2	Deuterium
DAE	Diels-Alder ether
dB(A)	Decibel(s)
DC	Direct current
DCEC	Delaware County Electric Cooperative, Inc.
DDT	Deflagration-to-detonation transition
DFMA	Design for Manufacture and Assembly
DFT	Density functional theory
DFT-GGA	Density functional theory - gradient generalized approximation
DGAC	Dangerous Goods Advisory Council
DI	Deionized
dL/g	Deciliters per gram
DMC	Direct manufactured cost
DMFC	Direct methanol fuel cell
DNA	Deoxyribonucleic acid
DOD	Depth of discharge
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy

DOS	Density of states
DOT	U.S. Department of Transportation
DRIFTs	Diffuse reflectance infrared Fourier transform spectroscopy
DRS	Direct recoil spectroscopy
DSC	Differential scanning calorimetry
DVHS	Differential volumetric hydrogen storage
DVMT	Daily vehicle miles traveled
e^-	Electron
E	Potential
$E_{1/2}$	Half-wave potential
Ea	Activation energy
EC	European Community
ECA	Electrochemical area
ECC	Electrochemical compressor
ECE	Economic Commission for Europe
ECS	Electrochemical Society
ECSA	Electrochemical surface area
ECTOS	Ecological City Transport System (Iceland)
EDAX	Manufacturer of energy dispersive X-ray hardware and software
EDC	Energy distribution curve
EDM	Electrical discharge machining
EDS	Energy dispersive x-ray spectroscopy
EDTA	Electric Drive Transportation Association
EDX	Energy dispersive x-ray analysis
EEA	Energy & Environmental Analysis, Inc.
EERE	U.S. DOE Office of Energy Efficiency and Renewable Energy
EESM	Electrical energy storage module
EGR	Exhaust gas recirculation
EIA	Energy Information Administration of the U.S. Department of Energy
EIS	Electrochemical impedance spectroscopy
ELAT®	Registered Trademark of De Nora North America, Inc., covers GDLs and GDEs
EMC	Electromagnetic compatibility
EMI	Electro magnetic interference
EMTEC	Edison Materials Technology Center
Ep	Peak potential
EPA	U.S. Environmental Protection Agency
EPD	End point detection
EPR	Electron paramagnetic resonance
ES	Energy storage
ESD	Electro-static discharge
ESR	Electron spin resonance
EtOH	Ethanol
eV	Electron volt
EW	Enthalpy wheel
EW	Equivalent weight
EXAFS	Extended x-ray absorption fine structure analysis
F	Fluorine
F^-	Fluorine ion
FC	Fuel cell
FCB	Fuel cell bus
FCCP	Carbonyl cyanide m-chlorophenylhydrazone
FCE	FuelCell Energy
FCFP	FreedomCAR and Fuel Partnership
FCV	Fuel cell vehicle
Fd	Ferredoxin
FE	U.S. DOE Office of Fossil Energy
Fe	Iron
Fe_2O_3	Ferric oxide
FEA	Finite element analysis
FEP	Fluorinated ethylene propylene; Teflon®
FER	Fluoride emission rate
FERC	Federal Energy Regulatory Commission
fg-ELAT	Fine gradient ELAT
FGHA	Forming gas hydrogen electode
FHWA	Federal Highway Administration
FIB	Focused ion beam
FLC	Flowering Locus C
FMEA	Failure modes and effects analysis
^{19}FNMR	^{19}Fluorine nuclear magnetic resonance
FP	Fuel processor
fpm	Feet per minute
FPS	Fuel processing system
FRP	Fiber-reinforced polymer
FRS	Functional requirement specifications
F-SPEEK	Fluorosulfonic acid of polyetheretherketone
FST	FuelSell Technologies
ft	Feet
ft^2	Square feet
ft^3	Cubic feet
FTA	Federal Transit Administration

FT-IR, FTIR	Fourier transform infrared
FTIR-ATR	Fourier transform infrared attenuated total reflection
FTP	Federal Test Procedure
fWGS	Forward water-gas shift
FY	Fiscal year
G	Graphite
g	Gram
g/cc	Grams per cubic centimeter
g/min	Grams per minute
g/s	Grams per second
Ga	Gallium
GaAs	Gallium arsenic
GADDS	General area diffraction system
gal	Gallon
GAMA	Gas Appliance Manufacturers Association
GAMS	Generalized Algebraic Modeling System, a commercially available software designed for linear and non-linear optimization
GaP	Gallium phosphide
GC	Gas chromatograph
GC	Glassy, or vitreous carbon; a pure carbon that is amorphous (non-crystalline)
GCMC	Grand Canonical Monte Carlo
GC/MS	Gas chromatograph/Mass spectroscopy
GC5T	GenCore 5T platform prototype back-up fuel cell design for telecommunications
GCtool	Software package developed at ANL for analysis of fuel cells and other power systems
Gd	Gadolinium
GDC	Gadolinium-doped ceria
GDE	Gas diffusion electrode
GDL	Gas diffusion layer
Ge	Germanium
GE	General Electric
GES	Giner Electrochemical Systems, LLC
GF	Glass fiber
GGA	Gradient generalized approximation
GGE, gge	Gasoline gallon equivalent
GH_2	Gaseous hydrogen
GHG	Greenhouse gas
GHSV	Gas hourly space velocity
GIS	Geographic information system
GJ	Gigajoule(s)
g/kW	Gram(s) per kilowatt
GLY	Glycerol
GM	General Motors
gm	Gram(s)
gm/day	Gram(s) per day
g/min	Gram(s) per minute
GNF	Graphite nanofiber
GPa	Gigapascal(s)
GPS	Global positioning system
GREET	Greenhouse Gas Energy and Emissions in Transportation model
GRPE	Working Party on Pollution and Energy
GSAS	General Structure Analysis System
GTI	Gas Technology Institute
GTR	Global Technical Regulations
GV	Gasoline vehicle
GWe	Gigawatt(s) electric
h	Hour(s)
H	Hydrogen
H+	Proton
ΔH	Enthalpy
H_2	Diatomic hydrogen
H_2A	Hydrogen Analysis project sponsored by DOE
HAD	Hydrogen adsorption/desorption
HAMMER	Hazardous Materials Management and Emergency
HARC	Houston Advanced Research Center
HATCI	Hyundai-KIA America Technical Center Inc.
HAZOP	Hazards and Operational Safety Analysis; Hazards and Operability Analysis
HBr	Hydrogen bromide
HBU	Hydrogen-based unit
HCG	Hydrogen Coordinating Group
HCl	Hydrochloric acid
$HClO_4$	Perchloric acid
HCNG	Hydrogen-compressed natural gas
HCO_3^-	Bicarbonate
HC&S	Hawaiian Commercial and Sugar Company
He	Helium
HER	Hydrogen evolution reaction
HEV	Hybrid electric vehicle
Hf	Hafnium
HF	Hydrofluorhydric acid; hydrogen fluoride

HFCIT	Hydrogen, Fuel Cells and Infrastructure Technologies Program
HFCTF	Hawaii Fuel Cell Test Facility
HFI	Hydrogen Fuel Initiative
HFR	High-frequency impedance; high-frequency resistance
HFSF	High-Flux Solar Furnace
HFSS	High-Flux Solar Simulator
HGM	Hydrogen Generation Module
HGMS	Hollow glass microsphere
HHV	Higher heating value
HI	Hydrogen iodide
HIA	Hydrogen Implementing Agreement
H_2 ICE	Hydrogen-fueled internal combustion engine
HiPCO, HiPCo	High-pressure carbon monoxide
HIx	Blend of hydrogen iodide, iodine, and water
HMC	Hyundai Motor Company
HMM	Hidden Markov Model
HNEI	Hawaii Natural Energy Institute
HNO_3	Nitric acid
H_2O	Water
H_2O_2	Hydrogen peroxide
HOMO	Highest occupied molecular orbital
HOR	Hydrogen oxidation reaction
HP	High-pressure
Hp	Average pool height
hp	Horsepower
HPA	Heteropolyacid
HPE	Hybrid photoelectrode
HPLC	High performance liquid chromatograph
H_3PO_4	Phosphoric acid
hr	Hour(s)
HRL	HRL Laboratories, LLC
HRTEM	High-resolution transmission electron microscopy
H_2S	Hydrogen sulfide
HSC	Database name derived from the letters for enthalpy, entropy and heat capacity
HSDC	Hydrogen Secure Data Center
HSO_4	Bisulfate anion
H_2SO_4	Sulfuric acid
HSRP	Hydrogen Safety Review Panel
HT	High-temperature
HTE	High-temperature electrolysis
H2TEC	Virginia-Maryland Hydrogen Technology Education Center
HTF	Heat transfer fluid
HTFC	High-temperature fuel cell
HTGR	High-temperature gas-cooled reactor
HTHX	High-temperature heat exchanger
HTM	High-temperature membrane
HTM	Hydrogen transport membrane
HTPSS	High-throughput photoelectro-chemical screening system
HTS	High-temperature shift
H2USA	Hydrogen Technology Learning Centers (for CA, FL, and NY)
HVAC	Heating, ventilation and cooling
HWSS	Hardwired safety system
HX	Heat exchanger
HyDS model	Hydrogen deployment system model
HyS	Hybrid sulfur
HyTEC	Hydrogen Technology and Energy Curriculum
Hythane	Compressed hydrogen natural gas blend
Hz	Hertz
HZM	Hot zone module
I	Current
I_2	Diatomic iodine
IBAD	Ion beam assisted deposition
IBS	Ion beam sputtering
IC	Internal combustion
ICAO	International Civil Aviation Organization
ICC	International Code Council
ICE	Internal combustion engine
ICEV	Internal combustion engine vehicle
ICMS	Integrated ceramic membrane system
ICP	Inductively coupled plasma
ICP-MS	Inductively coupled plasma mass spectrometry
ICP-OES	Inductively coupled plasma optical emission spectroscopy
ICR	Interfacial contact resistance
ID, i.d.	Internal diameter
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IEC	Ion exchange capacity
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IEEE PVSC	IEEE Photovoltaic Specialists Conference
IGCC	Integrated gasified combined cycle

IGT	Institute of Gas Technology
IIT	Illinois Institute of Technology
IMECE	International Mechanical Engineering Congress and Expo
In	Indium
In., in	Inch
in^2	Square inch
INERI	International Nuclear Energy Research Initiative
INL	Idaho National Laboratory
INMM	Institute for Nuclear Materials Management
InP	Indium phosphorus
IP	Intellectual property
IPCE	Incident photon conversion to electrons
IPE	Integrated photovoltaic electrolysis
IPHE	International Partnership for the Hydrogen Economy
IPNS	Intense Pulse Neutron Scattering Facility at Argonne National Laboratory
IR	Infrared
Ir	Iridium
iR	Internal resistance; voltage loss due to resistance
IRMOF	Isoreticular metal organic framework
IRR	Internal rate of return
ISE	International Society of Electrochemistry
ISO	International Organization for Standardization; International Standards Organization
IT	Information technology
ITM	Ion transport membrane
ITO	Indium tin oxide
IUPAC	International Union of Pure and Applied Chemistry
I-V	Current-voltage
J	Current
J	Joule(s)
JM	Johnson Matthey
JPL	Jet Propulsion Laboratory
K	Kelvin
K	Potassium
kÅ	1000 angstroms
KAIST	Korea Advanced Institute of Science and Technology
kA/m^2	Kilo-ampere(s) per square meter
kb	Kilo-base pair, a unit of measurement used in genetics equal to 1,000 nucleotides
KBr	Potassium bromide
kcal	Kilocalorie(s)
kcal/mol	Kilocalorie(s) per mole
KeV	Kilo electron volt(s)
kg	Kilogram(s)
kg/day	Kilogram(s) per day
kg/hr	Kilogram(s) per hour
kg/m^3	Kilogram(s) per cubic meter
KH	Potassium hydride
kHz	Kilohertz
KIC	Key industrial collaborators
kJ	Kilojoule(s)
kJ/mol	Kilojoule(s) per mole
km	Kilometer(s)
KMC	Kia Motors Corporation
KOH	Potassium hydroxide
kPa	Kilopascal(s)
kph	Kilometer(s) per hour
ksi	1,000 pound-force per square inch
kT/y	Kiloton(s) per year
kW	Kilowatt(s)
kWe	Kilowatt(s) electric
kWh	Kilowatt-hour(s)
kWh/kg	Kilowatt-hour(s) per kilogram
kWh/L	Kilowatt-hour(s) per liter
kW/kg	Kilowatt(s) per kilogram
kWt	Kilowatt(s) thermal
L, l	Liter(s)
La	Lanthanum
LANL	Los Alamos National Laboratory
LAO	Lanthanum-modified alumina
LAX	Los Angeles International Airport
lb	Pound(s)
lbmol	Pound-mole(s)
LBNL	Lawrence Berkeley National Laboratory
LCA	Life cycle assessment
LCC	Lansing Community College
LCC	$La_{0.7}Ca_{0.3}CrO_{3-\delta}$
LCHPP	Low Cost Hydrogen Production Platform (DOE Program Title)
L/D ratio	Ratio of length to diameter
LDC	Local Distribution Company
LDV	Light-duty vehicle
LECO	Instrument for fixed oxygen determination
LEED	Low-energy electron diffraction

LEEM	Low-energy electron microscopy
LEIS	Low-energy ion scattering
LEL	Lower explosion limit
LEMSYS	Local Energy Management System
LERDWG	U.S. DOE Laboratory Energy R&D Working Group
LES	Locally enhanced sampling
LFL	Lower flammability limit
L/h, l/h	Liter(s) per hour
LH_2	Liquid hydrogen
LHC	Light-harvesting chlorophyll
LHS	Lawrence Hall of Science
LHV	Lower heating value
Li	Lithium
$LiBH_4$	Lithium borohydride
LiH	Lithium hydride
Li_3N	Lithium nitride
LLC	Limited Liability Company
LLNL	Lawrence Livermore National Laboratory
LMDS	Laser modulation differential spectroscopy
L/min, l/min	Liter(s) per minute
LNG	Liquefied natural gas
LP	Lattice parameter
LPG	Liquefied petroleum gas
LPM	Liters per minute
LSL	Lower specification limit
LT	Low-temperature
LTS	Low-temperature shift
LTU	Lawrence Technological University
LWR	Light water reactor
LUMO	Lowest unoccupied molecular orbital
m	Meter(s)
M	Molar
m^2	Square meter(s)
m^3	Cubic meter(s)
m^2/g	Square meter(s) per gram
m^2/s	Square meter(s) per second
M31	Atofina membrane candidate
MA	Mechanical alloying
mA	MilliAmps
μA	Micro ampere(s)
mA/cm^2	Milliamp(s) per square centimeter
$\mu A/cm^2$	Micro ampere(s) per square centimeter
MACRS	Modified Accelerated Cost Recovery Schedule
MAOP	Maximum allowable operating pressure
MARKAL	A generic, multi-sector energy model developed by the Energy Technology Systems Analysis Program of the International Energy Agency
MAS-NMR	Magic angle spinning nuclear magnetic resonance
MBE	Molecular beam epitaxy
MBL	Modified boundary layer
$mC\text{-}cm^{-2}$	MilliCouloumb(s) per square centimeter
MCEL	Millenium Cell, Inc.
MCFC	Molten carbonate fuel cell
MD	Machine direction
MD	Molecular dynamics
MDCA	Metal-doped carbon aerogels
MEA	Membrane-electrode assembly
MEI	Makel Engineering
MEMS	Micro Electromechanical System
MEMSYS	Micro-grid Energy Management System
MeOH	Methanol
meq	Milliequivalents
meq/g	Milliequivalents/gram
MeV	Mega electron volt
Mg	Magnesium
Mg	Megagram(s)
μg	Microgram(s)
mg	Milligram(s)
$Mg(OH)_2$	Magnesium hydroxide
mg/cm^2	Milligram(s) per square centimeter
$MgCl_2$	Magnesium chloride
MgH_2	Magnesium hydride
MH	Metal hydride
MHCoE	Metal Hydride Center of Excellence
MHz	Megahertz
MI	Melt infiltration
mi	Mile(s)
mi/kg	Mile(s) per kilogram
mil	Millimeter(s)
min	Minute(s)
MIT	Massachusetts Institute of Technology
MJ	Megajoule(s)
ML	Monolayer
mL, ml	Milliliter(s)
μm	Micrometer(s); micron(s)
μM	Micromolar

mM	Millimolar
mm	Millimeter(s)
MMBtu	Million British thermal units
mmol	Millimole(s)
µmol	Micromole(s)
Mn	Manganese
MnO	Manganese oxide
Mn_2O_3	Manganese oxide
MOF	Metal organic framework
Mo	Molybdenum
mol	Mole(s)
mol%	Mole percent
mol/min	Mole(s) per minute
MoPc	Molybdenum phthalocyanine
MPa	Megapascal
MPG, mpg	Mile(s) per gallon
mph	Mile(s) per hour
MPL	Microporous layer
MR	Membrane reactor
MRI	Magnetic resonance imaging
MRS	Materials Research Society
ms	Millisecond(s)
mS/cm	Milli-Siemen(s) per centimeter
MSHA	Mine Safety and Health Administration
MSI	Metal-support interaction
MSM	Macro-System Model
MSP	Molten state processing
MSRI	Materials and Systems Research, Inc.
MST, MS&T	Materials Science and Technology
MSU	Montana State University
MTO	Mass transport overpotential
µV	Micro volt(s)
mV	Millivolt(s)
mW	Milliwatt(s)
MW	Megawatt(s)
MW	Molecular weight
mΩ	Milli-ohm(s)
MΩ	Mega-ohm(s)
$m\Omega/cm^2$	Milli-ohm(s) per square centimeter
$\mu\Omega\text{-}cm^2$	Micro-ohm(s) - square centimeter
mW/cm^2	Milliwatt(s) per square centimeter
MWe	Megawatt(s) electric
MWh	Megawatt-hour(s)
MWOE	Midwest Optoelectronics, LLC
MWth	Megawatt(s) thermal
MYPP	Multi-Year Program Plan (the HFCIT Program's Multi-Year Research, Development and Demonstration Plan)
MYRDDP	Multi-Year Research, Development and Demonstration Plan
N	Normal (e.g., 1N H_3PO_4 is 1 normal solution of phosphoric acid)
N	Nitrogen
N	Newton (unit of force)
N/cm^2	Newton(s) per square centimeter
N112	Nafion 1100 equivalent weight, 2 millimeter thick membrane
N_2	Diatomic nitrogen
Na	Sodium
NA-22	National Nuclear Security Administration, Office of Non-Proliferation Research and Engineering
Na_3AlH_6	Trisodium hexahydroaluminate
$NaAlH_4$	Sodium aluminum hydride; sodium tetrahydroaluminate; sodium alanate
$NaBH_4$	Sodium borohydride
$NaBO_2$	Sodium borate
NACE	National Association of Corrosion Engineers
NaCl	Sodium chloride
NACS	North American Catalysis Society
Nafion®	Registered Trademark of E.I. DuPont de Nemours
NaH	Sodium hydride
NA NG	North American natural gas
NaOH	Sodium hydroxide
Na_2S	Sodium sulfide
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NASA PERS	National Aeronautics and Space Agency Polymer Energy Rechargeable System
NAU	Northern Arizona University
NAVSEA	Carderock Naval Sea Systems Command Carderock Division
NAWC	Naval Air Warfare Center
Nb	Niobium
NCMS	National Center for Manufacturing Sciences
NCNR	NIST Center for Neutron Research
NCRC	New Concepts Research Corporation
ND	Not determined at this time
ND	Nitrogen donor
NDA	Non-disclosure agreement
NE	U.S. DOE Office of Nuclear Energy, Science and Technology

NEBS	Network Equipment Building Standards
NEC	NextEnergy Center
NEC	National Electrical Code
NEED	National Energy Education Development Project
NEMS	National Energy Modeling System
NERI	Nuclear Energy Research Initiative
NETL	National Energy Technology Laboratory
NEU	Northeastern University
NFC	Near frictionless carbon
NFPA	National Fire Protection Association
NG	Natural gas
ng	Nanogram
NGCC	Natural gas combined cycle
NH_3	Ammonia
NHA	National Hydrogen Association
NHE	Normal hydrogen electrode
NHI	Nuclear Hydrogen Initiative
NHTSA	National Highway Traffic Safety Administration of the U.S. Department of Transportation
Ni	Nickel
NICC	Natural gas Infrastructure Component Cost model
NiMH	Nickel metal hydride
NIST	National Institute of Standards and Technology
NL	Normal liter(s)
nm	Nanometer(s)
NM	Noble metal
Nm^3/h, nm^3/hr	Normal cubic meter(s) per hour
nmol	Nanomole(s)
NNA	Non-North American
NNA NG	Non-North American natural gas
NMR	Nuclear magnetic resonance
NMSU	New Mexico State University
NMTech	New Mexico Technological University
NO_2	Nitric oxide
N_2O	Nitrous oxide
NOx	Oxides of nitrogen
NPC	Nanoporous carbon
NPM	Non-precious metal
NPT	Normal pressure and temperature
NPV	Net present value
NRC	National Research Council
NREL	National Renewable Energy Laboratory
NSTF	Nanostructured thin film
NYSERDA	New York State Energy Research and Development Authority
O	Oxygen
O_2	Diatomic oxygen
O/C	Oxygen-to-carbon atomic ratio
OCP	Open circuit potential
OCV	Open circuit voltage
o.d.	Outer diameter
OEC	Oxygen evolving complex
OEM	Original equipment manufacturer
OGA	Online gas analyzer
OH^-	Hydroxyl radical
O&M	Operation and maintenance
OMB	Office of Management and Budget
ONR	Office of Naval Research
OPS	Office of Pipeline Safety
ORF	Opening Reading Frame indicating the occurence of a protein coding region in the DNA sequence
ORNL	Oak Ridge National Laboratory
ORR	Oxygen reduction reaction
OTM	Oxygen transport membrane
OTT	Office of Transportation Technologies
ΔP	Pressure drop, pressure change
P	Phosphorus
P	Pressure
Pa	Pascal(s)
PADD	Petroleum Administration for Defense District
PAFC	Phosphoric acid fuel cell
PANI	Polyaniline
Pb	Lead
PbA	Lead acid
PBI	Polybenzimidazole
PbO	Lead oxide
PC	Polycarbonate
PC	Personal computer
Pc	Phthalocyanines (e.g., MoPc, FePc)
PCAMM	Pacific Centre for Advanced Materials and Microstructures
PCF	Polycarbonate film
PCM	Power control module
PCR	Polymerase chain reaction
PCS	Power conditioning system

PCS	Plasma converter system
PCT, P-C-T	Pressure concentration temperature
Pd	Palladium
PDL	Polymer Data Library
PDS	Potentiodynamic scan
PDU	Process development unit
PE	Polyethylene
PEAR	Power and Energy Analytic Resources
PEC	Photoelectrochemical
PECH	Polyepichlorohydrin
PEEK	Polyether ether ketone
PEFC	Polymer electrolyte fuel cell
PEFC	Proton exchange fuel cell
PEI	Polyetherimide
PEKK	Poly (ether ketone ketone)
PEM	Polymer electrolyte membrane
PEM	Proton exchange membrane
PEMFC	Polymer electrolyte membrane fuel cell
PEMFC	Proton exchange membrane fuel cell
PEN	Positive-Electrolyte-Negative
PES	Polyether sulfone
PES	Power electronics system
PES	Power Engineering Society
PES	Proton Energy Systems, Inc.
PET	Polyethylene teraphthalate
PetF1	*Synechocystis* host ferredoxin
PFA	Perfluoroalkoxy (a type of fluoropolymer)
PFCT	Porvair Fuel Cell Technology, Inc.
PFD	Process flow diagram
PFG-NMR	Pulse field gradient nuclear magnetic resonance
PFSA	Perfluorinated sulfonic acid
PG	Propylene glycol
PGM	Platinum group metal
PI	Principal investigator
pics	Measurement of how close together fibers are woven
PID	Process identifier number
PITTCON	Pittsburgh Conference and Exhibition for Analytical Chemistry
Pl	Platinum
PLC	Programmable logic controller
PLS	Polymer-layered silicate
PM	Precious metal, such as platinum
PM_{10}	Particulate matter with diameters of 10 micrometers or less
P/M	Powder metallurgy
PMG	Glycidyl methacrylate-type copolymer
PND	Polymerized nitrogen donor
PNNL	Pacific Northwest National Laboratory
POX	Partial oxidation
ppb	Parts per billion
ppbv	Part(s) per billion by volume
PPI	Pore(s) per inch
ppm, PPM	Part(s) per million
ppmv	Part(s) per million by volume
ppmw	Part(s) per million by weight
Pr	Praseodymium
PRA	Probabilistic risk assessment
PrOx	Preferential oxidation
PS	Photosystem
PSA	Pressure swing adsorption
PSAT	Vehicle simulation software package developed at Argonne National Laboratory - Power-train System Analysis Toolkit
PSD	Particle size distribution
psi, PSI	Pound(s) per square inch
psia	Pound(s) per square inch absolute
psid	Pound(s) per square inch differential
psig	Pound(s) per square inch gauge
PSI	Photosystem I
PSII	Photosystem II
PSM	Plant support module
PSS	Potentiostatic scan
PSU	Pennsylvania State University
PSU OPP	Pennsylvania State University, Office of Physical Plant
PSU PTI	Pennsylvania State University, Pennsylvania Transportation Institute
Pt	Platinum
P-T	Pressure-temperature
PTA	Phosphotungstic acid
Pt/C	Platinum/carbon
Pt_3Co	Platinum-cobalt alloy
Pt_3Fe	Platinum-iron alloy
PTFE	Teflon – poly-tetrafluoroethylene
Pt-FePO	Platinum iron phosphate
Pt-MM	Platinum group mixed metal
PTM	Proton transport membrane
PtML	Platinum monolayer
Pt_3Ni	Platinum-nickel alloy
PTO	Power take-off
PtO_2	Platinum dioxide

Pt-TaPO	Platinum tantalum phosphate
PTW	Pump-to-wheel
PUC	Public Utility Commission
PV	Photovoltaic
PVC	Polyvinyl chloride
PVDF	Polyvinylidenefluoride
PVP	Polyvinylpyrrolidone
PVT, P-V-T	Pressure-Volume-Temperature
Q1, Q2, Q3, Q4	Quarters of the fiscal year
RA	Reduction in area
R&D	Research and development
RD&D, R,D&D	Research, development & demonstration
RDE	Rotating disk electrode
Re	Rhenium
REWP	Renewable Energy Working Party
RF	Radio frequency
RFC	Regenerative fuel cell
RFP	Request for proposals
RH	Relative humidity
Rh	Rhodium
RHE	Reference hydrogen electrode; reversible hydrogen electrode
RHLC	Relative humidity/load cycle test
RPI	Rensselaer Polytechnic Institute
rpm	Revolution(s) per minute
RRDE	Rotating ring disc electrode
RSOFC	Regenerative solid oxide fuel cell
RT	Room temperature
RTC	Regional Transportation Commission
Ru	Ruthenium
s	Second(s)
S	Siemen(s)
S	Sulfur
SA	Surface area
SAE	Society of Automotive Engineers
SAH	Sodium aluminum hydride
SAM	Scanning Auger microscopy
SAMPE	Society for the Advancement of Material and Process Engineering
SAT	Site acceptance test
SAXS	Small angle x-ray scattering analysis
SBIR	Small Business Innovative Research
SBP	Solution based processing
Sc	Scandium
S/C	Steam to carbon ratio
SCC	Stress corrosion cracking
sccm, SCCM	Standard cubic centimeter(s) per minute
SCE	Southern California Edison
SCE	Saturated calomel electrode
SCF, scf	Standard cubic feet
scfd	Standard cubic feet per day
SCFH, scfh	Standard cubic feet per hour
SCFM	Standard cubic feet per minute
SCIA	South Central Industrial Association
S/cm	Siemen(s) per centimeter
SD	Standard deviation
SDAPP	Sulfonated Diels-Alder polyphenylene
SDAPPe	Sulfonated Diels-Alder ether
SDE	SO_2-depolarized electrolyzer
SDO	Standards Development Organization
Se	Selenium
sec	Second(s)
SECA	Solid State Energy Conversion Alliance
SEM	Scanning electron microscopy
SEM	Secondary electron microscopy
SEMaC	Smart Energy Management Controller
SEP	Subscale engineering prototype
SERC	Schatz Energy Research Center
SF_6	Sulfur hexafluoride
SFA	Sulfonic acid
S-G	Secretary-General
SHE	Standard hydrogen electrode
SHGR	Solar Hydrogen Generation Research
Si	Silicon
S-I	Sulfur - iodine
SiC	Silicon carbide
SIMS	Secondary ion emission spectroscopy
SiO_2	Silicon dioxide
SLPM, SLM, sL/min	Standard liter(s) per minute
SM	Surface modifier
SMAE	Solid membrane alkaline electrolyzer
SME	Mercury sulfate electrode
SMR	Steam methane reformer; steam methane reforming
Sn	Tin
SNL	Sandia National Laboratories
SNLL	Sandia National Laboratory Livermore
SnO	Tin oxide

SnO_2	Tin oxide
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
SOC	State of charge
SOEC	Solid oxide electrolysis cell; solid oxide electrolyzer cell
SOFC	Solid oxide fuel cell
SOFEC	Solid oxide fuel-fed electrolysis cell
SOM	Solid-oxide oxygen-ion-conducting membrane
SOO	Statement of Objectives
SORFC	Solid oxide regenerative fuel cell
SOx	Oxides of sulfur
SPEKK	Sulfonated polyether ether ketone
SPR	Solid particle receiver
sq. in.	Square inch(es)
Sr	Strontium
SR	Steam reformer; steam reforming
SRM	Steam reforming
SRM	Standard reference material
SRNL	Savannah River National Laboratory
SS	Stainless steel
SSA	Specific surface area
SSP	Solid state processing
SSR	Spiral stackable reactor
SSRL	Stanford Synchrotron Radiation Laboratory
STA	Silicotungstic acid
STAC	State Technologies Advancement Collaborative
STD	Soon to demonstrate
STEM	Scanning transmission electron microscopy
STH	Solar-to-hydrogen
STM	Scanning tunneling electron microscopy
STP	Standard temperature and pressure
STTP	Shared Technology Transfer Project
STTR	Small Business Technology Transfer
SUNY	State University of New York
SV	Space velocity
SWCNT	Single-walled carbon nanotube
SWNH	Single-walled nanohorn
SWNT	Single-walled nanotube
SwRI	Southwest Research Institute
T	Temperature
T	Ton
t	Time
Ta	Tantalum
TAG	Technical Advisory Group
TAP	Tandem affinity purification
TaPO	Tantalum phosphate
TBD	To be determined
TBX	Turboexpander
TC	Thermocouple
TC	Thermochemical
TC	Technical Committee
TCCR	Transparent, conducting and corrosion resistant
TCWC	Thermochemical water cracking
TD	Transverse direction
Te	Tellurium
TEAB	Tetraethyl ammonium borohydride
TEM	Transmission electron microscopy
TESI	Teledyne Energy System Inc.
TFMSA	Trifluoromethane sulfonic acid
tf-Si	Thin film silicon
Tg	Glass transition temperature
TGA	Thermal gravimetric analysis; thermogravimetric analysis; thermal gravimetric analyzer
TGC	Tail gas combustor
TGP-H	Toray graphite paper - high conductivity
THC	Total hydrocarbons
THF	Tetrahydrofuran
Ti	Titanium
$TiCl_3$	Titanium trichloride
TiF_3	Titanium trifluoride
TiH_2	Titanium hydride
TiO_2	Titanium dioxide (anatase)
TIVM	Toroidal intersecting vane machine
Tla	Truncated light-harvesting chlorophyll antenna
tla1	Mutant of the Tla1 gene (GenBank Assession No. AF534570)
tlaX	Mutant of unknown gene with a truncated light-harvesting chlorophyll antenna (GenBank Assession No. AF534571)
TM	Transition metal
TMPP	Tetramethoxyphenyl porphyrins
TMS	The Minerals, Metals and Materials Society
TOS	Time on stream
TPD	Tons per day
TPD	Thermally programmed desorption; Temperature-programmed desorption
TPO	Temperature-programmed oxidation

TPP	Tetraphenyl porphyrin
TPR	Temperature-programmed reduction
TRL	Technology readiness level
tr. oz.	Troy ounce
TRU	Trailer refrigeration unit
TSA	Transportation Security Administration
TSSER	Thermal swing sorption enhanced reaction
TT	Thermal treatment
TWM	Thermal and water management
UC	University of California
UCI	University of California, Irvine
UCLA	University of California, Los Angeles
UCONN	University of Connecticut
UCSB	University of California, Santa Barbara
UEA	Unitized electrode assembly
UGA	University of Georgia, Athens
UH	University of Hawaii
UHV	Ultra-high vacuum
UIUC	University of Illinois, Urbana-Champaign
UL	Underwriters Laboratory
ULSD	Ultra-low sulfur diesel
um	Micrometer(s)
UMCP	University of Maryland College Park
UN	United Nations
UNC	University of North Carolina
UNLV	University of Nevada Las Vegas
UNLVRF	UNLV Research Foundation
UNM	University of New Mexico
UNR	University of Nevada, Reno
UPS	Ultraviolet photoelectron spectroscopy
U.S.	United States
USA	United States of America
USC	University of South Carolina
USC	University of Southern California
USCAR	U.S. Cooperative Automotive Research
USFCC	United States Fuel Cell Council
USL	Upper specification limit
USM	University of Southern Mississippi
USP	Ultrasonic spray pyrolysis
UT	University of Toledo
UTC, UTC FC	United Technologies Corporation Fuel Cells
UTC	University of Tennessee, Chattanooga
UTR	Untranslated region
UTRC	United Technologies Research Center
UV	Ultraviolet
UV-vis	Ultraviolet-Visual
UW	University of Washington
V	Vanadium
V	Volt
VAC	Volts alternating current
VASP	Vienna Ab-initio Simulation Package
VaTech	Virginia Polytechnic Institute and State University
VC	Vulcan carbon
VDC	Volts direct current
vdW	van der Waals
VF	Value function
VHTS	Virtual high-throughput screening
V-I	Voltage - current
VIR	Voltage - current - resistance
VMT	Vehicle miles travelled
VNT	Variable nozzle turbine
vol	Volume
vol%	Volume percent
VTA	Valley Transportation Authority
VTGR	Very high temperature gas reactor
VTNA	Volvo Trucks North America
Ω	Ohm(s)
W	Tungsten
W	Watt(s)
WAXD	Wide-angle x-ray diffraction
WBS	Work breakdown schedule
Ωcm^2	Ohm(s) - square centimeter
W/cm^2	Watt(s) per square centimeter
We	Watt(s) electric
WGS	Water gas shift
WGS-MR	Water gas shift membrane reactor
Wh	Watt-hour(s)
W-h/kg	Watt-hour(s) per kilogram
W-h/L, Wh/liter, Wh/L	Watt-hour(s) per liter
WHSV	Weight hourly space velocity
W/kg	Watt(s) per kilogram
W/L, W/l	Watt(s) per liter
W/m-K, W/m.K, W/mK	Watt(s) per meter-Kelvin (unit of thermal conductivity)
WO_3	Tungsten trioxide

WOM	Weatherometer
Wt	Watt(s) thermal
wt	Weight
wt%, wt.%	Weight percent (percent by weight)
WTP	Water transfer plate
WTP	Well-to-pump
WTW	Well-to-wheel
w/v	Weight by volume
XAS	X-ray absorption spectroscopy
XPS	X-ray photoelectron spectroscopy
XRD	X-ray diffraction
XRF	X-ray fluorescence
Y	Yttrium
yr	Year
YSZ	Yttria-stablized zirconia
Zn	Zinc
ZnO	Zinc oxide
Zr	Zirconium
ZrO_2	Zirconium dioxide