

### XIII. Acronyms, Abbreviations and Definitions

°C	Degrees Celsius	A	Ampere, amps
°F	Degrees Fahrenheit	Å	Angstrom
$\alpha$ -AlH <sub>3</sub>	Alpha polymorph of aluminum hydride	AAO	Anodic aluminum oxide
$\Delta$	Change, delta	AB	Ammonia-borane, NH <sub>3</sub> BH <sub>3</sub>
$\Delta G$	Gibbs free energy of reaction	ABH <sub>2</sub>	Ammonium borohydride, NH <sub>4</sub> BH <sub>4</sub>
$\Delta H$	Enthalpy of reaction, enthalpy of hydrogenation	ABI	Automated ball indentation
$\Delta H^\circ_f$	standard heat of formation	ABMS	Agent-based modeling and simulation
$\Delta K$	Stress intensity factor	AC	Alternating current
$\Delta P$	Pressure drop, pressure change	A/cm <sup>2</sup>	Amps per square centimeter
~	Approximately	ACR	Autothermal cyclic reforming
≈	Equals approximately	ACS	American Chemical Society
>	Greater than	AECL	Atomic Energy Canada, Limited
≥	Greater than or equal to	AEO	Annual Energy Outlook
<	Less than	AER	Absorption-enhanced reforming, all-electric range
≤	Less than or equal to	AES	Auger electron spectroscopy
@	At	AFCIA	Advanced Fuel Cells Implementing Agreement
#	Number	AFM	Atomic force microscopy; anti-ferromagnetic
%	Percent	AFP	Automated fiber placement
®	Registered trademark	AFV	Alternative fuel vehicle
μA	Micro ampere(s)	Ag	Silver
μA/cm <sup>2</sup>	Micro ampere(s) per square centimeter	AgCl	Silver chloride
μc-Si	Microcrystalline silicon	AHJ	Authorities having jurisdiction
μg	Microgram(s)	AIChE	American Institute of Chemical Engineers
μm	Micrometer(s); micron(s)	AIGSe	Ag(In <sub>0.2</sub> Ga <sub>0.8</sub> )Se <sub>2</sub>
μM	Micromolar	AISI	American Iron & Steel Institute
μmol	Micromole(s)	AIST	Japanese National Institute of Advanced Industrial Science and Technology
μΩ-cm <sup>2</sup>	Micro-ohm(s)-square centimeter	Al	Aluminum
μV	Micro volt(s)	Al <sub>2</sub> O <sub>3</sub>	Aluminum oxide
η	Viscosity	AlCl <sub>3</sub>	Aluminum chloride
Ω	Ohm(s)	ALD	Atomic layer deposition
Ω/cm <sup>2</sup>	Ohm(s) per square centimeter	AlH <sub>3</sub>	Aluminum hydride; alane
Ω-cm <sup>2</sup>	Ohm-square centimeter	ALS	Advanced light source at Lawrence Berkeley National Laboratory
\$	United States dollars	ALT	Accelerated life test
<sup>11</sup> B-NMR	Boron 11 Nuclear Magnetic Resonance	AM 1.5	Air Mass 1.5 solar illumination
<sup>19</sup> FNMR	<sup>19</sup> Fluorine nuclear magnetic resonance	AMPS	2-acryloamido-2-methyl-1-propanesulfonic acid
1-D, 1D	One-dimensional	AMR	Annual Merit Review
1Q	First quarter of the fiscal year	AMRL	Active magnetic regenerative liquefier
2-D, 2D	Two-dimensional	AN	Acrylonitrile
2Q	Second quarter of the fiscal year		
3-D, 3D	Three-dimensional		
3Q	Third quarter of the fiscal year		
4Q	Fourth quarter of the fiscal year		
8YSZ	8 mol% yttria-stabilized zirconia		

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ANL	Argonne National Laboratory	Be	Beryllium
ANSI	American National Standards Institute	BE-O	Binding energy of oxygen
$A_0$	Arrhenius constant, ml/[cm <sup>2</sup> -min-atm <sup>1/2</sup> ]	BET	Brunauer-Emmett-Teller surface area analysis method
APCI	Air Products and Chemicals, Inc.	BFR	Base-facilitated reforming
API	American Petroleum Institute	BFZO	BaFe <sub>0.975</sub> Zr <sub>0.025</sub> O <sub>3</sub>
APPO	Poly(2,6-dimethyl-1,4-phenylene oxide) based carbon	BFZ1	BaFe <sub>0.90</sub> Zr <sub>0.10</sub> O <sub>3</sub>
APR	Aqueous-phase reforming	B-H, BH, BH <sub>4</sub>	Borohydride
APRxn	Aqueous phase reaction	Bi	Bismuth
APS	Advanced Photon Source	BKDF	Bioenergy Knowledge Discovery Framework
APU	Auxiliary power unit	bmimCl	1-butyl-3-methyl-imidazolium chloride
Ar	Argon	BN	Boron-nitrogen
ARET	Alternative and renewable energy technologies	BNH	Boron-nitrogen-hydrogen
ARRA	American Recovery and Reinvestment Act	BNHx	Dehydrogenated ammonia-borane
As	Arsenic	BNL	Brookhaven National Laboratory
a-Si	Amorphous silicon	BOL	Beginning of life
a-SiC	Amorphous silicon carbide	BOP, BoP	Balance of plant
a-SiGe	Amorphous silicon germanium	<sup>11</sup> B-NMR	Boron 11 Nuclear Magnetic Resonance
a-SiN	Amorphous silicon nitride	BP	Bisphenol
ASME	American Society of Mechanical Engineers	BPS	Ballard Power Systems, biphenyl sulfone
ASPEN	Modeling software, computer code for process analysis	BPS100	fully disulfonated poly(arylene ether sulfone)
ASR	Area-specific resistance	BPSH	Block polysulfone ether polymers, biphenyl sulfone: H form
AST	Accelerated stress test	BPSH-30	Biphenyl sulfone H form, 30% molar fraction of disulfonic acid unit (30% level of sulfonation)
ASTM	ASTM International, originally known as the American Society for Testing and Materials	BPSH-x	BiPhenyl-based disulfonated polySulfone (H+ form) (x denotes degree of sulfonation)
at%	Atomic percent	Br <sub>2</sub>	Diatomic bromine
A-T-P	Aerosol through plasma	BSC	Bi-electrode supported cell
ATP	Adenosine triphosphate	BSE	Bachelor of Science in Engineering
ATPase	Adenosine triphosphatase	BSET	Bachelor of Science in Engineering Technology
ATR	Autothermal reformer; autothermal reforming, attenuated total reflection	BTB	1,3,5-benzenetribenzoate
ATR-FTIR	Attenuated total reflectance Fourier transform infrared	BTC	1,3,5-benzenetricarboxylate
ATV	All-terrain vehicle	BTT	Benzene tris-tetrazole
Au	Gold	BTU, Btu	British thermal unit(s)
a.u.	Arbitrary units	BZYC	BaZr <sub>0.1</sub> Ce <sub>0.7</sub> Y <sub>0.1</sub> Yb <sub>0.1</sub> O <sub>3-δ</sub>
Avg	Average	C	Carbon
B	Boron	Ca	Calcium
Ba	Barium	CA	Carbon aerogel
BCC	Body-centered cubic	CaCO <sub>3</sub>	Calcium carbonate
BCM	Battery-charging mode	CAD	Computer-aided design
BCN	Boron carbon nitride	CAE	Computer-assisted engineering
BCP	Block copolymers	CAES	Compressed air energy storage

CaFCP	California Fuel Cell Partnership	CH	Hydrogenated graphene
CAFE	Corporate Average Fuel Economy	CH <sub>2</sub>	Compressed hydrogen gas
CALPHAD	Calculation of phase diagrams	CH <sub>4</sub>	Methane
Caltech	California Institute of Technology	C <sub>2</sub> H <sub>4</sub>	Ethylene
CaO	Calcium oxide	C <sub>2</sub> H <sub>6</sub>	Ethane
CARB	California Air Resources Board	C <sub>3</sub> H <sub>8</sub>	Propane
CaS	Calcium sulfide	CHARM	Cost-effective High-efficiency Advanced Reforming Module
CB	Conduction band	CHEX	Continuous catalytic heat exchanger
CBM	Conduction band minimum	CHHP	Combined heat, hydrogen, and power
CBN	Carbon-boron-nitrogen	Chl	Chlorophyll
CBS	Casa Bonita strain, complete basis set	CHP	Combined heat and power
cc	Cubic centimeter(s)	CHSCoE	Chemical Hydrogen Storage Center of Excellence
CC&S	Carbon capture and sequestration	CI	Compression ignition
CCD	Charge-coupled device	CIGS	Copper indium gallium diselenide
CcH <sub>2</sub>	Cryo-compressed hydrogen	CIGSe	Copper indium gallium diselenide
CCM	Catalyst-coated membrane, coordinate measuring machine	CIRRUS	Cell Ice Regulation & Removal Upon Start-up
Cc/min, ccm	Cubic centimeters per minute	CIS	CuInSe (alloy of copper, indium, and selenium)
ccp	Cubic close-packed	Cl	Chlorine
CCP	Combined cooling and power	CL	Catalyst layer, $\epsilon$ -caprolactone
CCS	Carbon capture and storage	cm	Centimeter
Cd	Cadmium	CM	Cyanamide
CD	Compact disk, charge depleting, cathode dewpoint	cm <sup>2</sup>	Square centimeter
cDNA	Complementary DNA	CMO	Conductive metal oxides
CDO	Code development organization	CMR	Composite membrane reactor
CDP	Composite data product	CMU	Carnegie Mellon University
CDR	Component design requirement	CMWNT	Carbon multi-walled nanotube
CdS	Cadmium sulfide	CNG	Compressed natural gas
C-DSM™	Chemically etched dimensionally stable membrane	CNT	Carbon nanotube
Ce	Cerium	Co	Cobalt
CEC	California Energy Commission	CO	Carbon monoxide
CEM	Compressor/expander motor	CO <sub>2</sub>	Carbon dioxide
CEMM	Compressor-expander motor module	CoE	Center of Excellence
CeO <sub>2</sub>	Ceric oxide	COE	Cost of electricity
CERL	Construction Engineering Research Laboratory	COF	Covalent-organic framework
CESA	Clean Energy States Alliance	COF <sub>2</sub>	Carbonyl fluoride
CF	Carbon fiber, carbon foam	COMSOL	Multiphysics modeling and engineering simulation software
CFCC	Colorado Fuel Cell Center	COPV	Composite overwrapped pressure vessel
CFD	Computational fluid dynamics	COS	Carbon oxysulfide; carbonyl sulfide
cfm	Cubic feet per minute	CPO, CPOX	Catalytic partial oxidation
CGA	Compressed Gas Association	Cr	Chromium
CGH <sub>2</sub>	Compressed gaseous hydrogen	CRADA	Cooperative Research and Development Agreement
CGS	Copper gallium diselenide, CuGaSe <sub>2</sub>		
CGSe	Copper gallium diselenide		

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Cs	Cesium	DOT	Department of Transportation
CS	Ceramic support	DP	Dew point
CSA	Canadian Standards Association	DRIFTS	Diffuse reflectance infrared Fourier transform spectroscopy
CSD	Compression-storage-delivery	DSC	Differential scanning calorimetry
CSM	Colorado School of Mines, combined structure and material	DSM™	Dimensionally stable membrane
CSR	Catalytic steam reforming, compressive stress relaxation	DST	Dynamic stress test
CTE	Coefficient of thermal expansion	DTI	Directed Technologies, Inc.
CTV	Chevron Technology Ventures LLC	e <sup>-</sup>	Electron
Cu	Copper	EASA	Electrochemically active surface area
Cu <sub>2</sub> O	Cuprous oxide	EC	European Commission, electro-chemical
cu. in.	Cubic inch	ECA	Electro-catalytic additive, electrochemical area
CuO	Cupric oxide, copper(II) oxide	ECSA	Electrochemically active surface area, electrochemical surface area
CV	Cyclic voltammetry, cyclic voltammogram	EDS	Energy dispersive X-ray spectroscopy, energy dispersive spectrum
CVD	Chemical vapor deposition	EDTA	Ethylenediamine tetraacetic acid
CWRU	Case Western Reserve University	EDX	Energy dispersive X-ray
CY	Calendar year	EELS	Electron energy loss spectroscopy
CZO	Ceria-zirconia	EEERE	U.S. DOE Office of Energy Efficiency and Renewable Energy
d	Day(s)	EFP	External fuel processor
D <sub>2</sub>	Deuterium	EFTE	Ethylene-tetrafluoroethylene
DAC	Direct air cooling	EHC	Electrochemical hydrogen compressor
DC	Direct current	EH&S	Environmental Health and Safety
DDP	Detailed data products	EIA	Energy Information Administration of the U.S. Department of Energy
$d_{DR}$	Dubini-Radushkevich average micropore diameter	EIS	Electrochemical impedance spectroscopy
Deg	Degree	ELAT®	Registered Trademark of De Nora North America, Inc., covers GDLs and GDEs
ΔK	Stress intensity factor	EMP	Electron microprobe
DFMA®	Design for Manufacturing and Assembly	EMTEC	Edison Materials Technology Center
DFT	Density functional theory	eNMR	Electrochemical nuclear magnetic resonance
DI	Deionized, de-ionized water	EOL	End of life
DLC	Diamondlike carbon	EPA	U.S. Environmental Protection Agency
dL/g	Deciliters per gram	EPDM	Ethylene propylene diene monomer
DM	Diffusion media	ePTFE	Expanded polytetrafluoroethylene
DMA	Dynamic mechanical analysis	ESA	Electrochemically active surface area
DMC	Diffusion Monte Carlo, direct manufactured cost	ESCO	Energy service company
DMDF	2,5-dimethoxy 2,5-dihydrofuran	ESEM	Environmental scanning electron microscopy
DME	Dimethyl ether, dimethoxyethane	ESR	Ethanol steam reforming, electron spin resonance
DMEA	Dimethylethylamine	ESS	Energy storage system
DMEAA	Dimethylethylamine alane	E-TEK	Division of De Nora North America, Inc.
DMFC	Direct methanol fuel cell	ETFE	Ethylene-tetrafluoroethylene
DNA	Deoxyribonucleic acid		
DOD	U.S. Department of Defense		
DOE	U.S. Department of Energy		
DOS	Density of states		

EtOH	Ethanol	FOM	Federated object model, figure of merit
ETR	Electron transfer rate	fpi	Fins per inch
EU	European Union	fpm	Feet per minute
eV	Electron volt	FPS	Bis(4-fluorophenyl)sulfone, fuel processing system
EVOH	Ethylene vinyl alcohol	FRC	Fiber-reinforced composite
EW	Equivalent weight	FRP	Fiber-reinforced polymer
EXAFS	Extended X-ray absorption fine structure analysis	FRR	Fluoride release rate
F	Fluorine	FSEC	Florida Solar Energy Center
F	Faraday constant, the amount of electric charge in one mole of electrons (96,485.3383 coulomb/mole)	ft	Feet
F <sup>-</sup>	Fluorine ion	FT	Fault tree
FA	Furfyl alcohol	ft <sup>2</sup>	Square feet
FAT	Fleet Analysis Toolkit	ft <sup>3</sup>	Cubic feet
FAU	Florida Atlantic University	FTA	Federal Transit Administration
FC	Fuel cell	FT-IR, FTIR	Fourier transform infrared
FCB	Fuel cell bus	FTIR-ATR	Fourier transform infrared attenuated total reflection
FCC	Face-centered cubic	FTO	Fluorine-doped tin oxide
FCE	FuelCell Energy	FTP	Federal Test Procedure
F-Cell	Daimler Fuel Cell vehicle	FW	Filament winding
FCEV	Fuel cell electric vehicle	FY	Fiscal year
FCS	Fuel cell system	ΔG	Gibbs free energy of reaction
FCT	Fuel Cell Technologies (Program)	g	Gram; acceleration of gravity
FCTES <sup>QA</sup>	Fuel Cell Testing, Safety and Quality Assurance (an international effort to harmonize fuel cell testing procedures)	G	Graphite
FCTESTNET	Fuel Cell Testing and Standardization Network	Ga	Gallium
FCTS	Fuel cell test station	GA	General Atomics
FCTT	Fuel Cell Technical Team	GaAs	Gallium arsenic
FCV	Fuel cell vehicle	GADDS	General area diffraction system
Fd	Ferredoxin	gal	Gallon
Fe	Iron	GAMS	Generalized Algebraic Modeling System, a commercially available software designed for linear and non-linear optimization
FE	U.S. DOE Office of Fossil Energy	GaP	Gallium phosphide
Fe <sub>2</sub> O <sub>3</sub>	Ferric oxide	GB	Gigabyte
FEA	Finite element analysis	GC	Gas chromatograph
FEP	Fluorinated ethylene propylene, Teflon <sup>®</sup>	GC	Glassy, or vitreous carbon; a pure carbon that is amorphous (non-crystalline)
FERC	Federal Energy Regulatory Commission	g/cc	Grams per cubic centimeter
FFT	Fast fourier transform	GCLP	Grand-canonical linear programming
FHI	Florida Hydrogen Initiative	GCMC	Grand Canonical Monte Carlo
FHWA	Federal Highway Administration	GCMS	Gas chromatograph mass spectroscopy
FIB	Focused ion beam	Gd	Gadolinium
FLUENT	Computer code for computational fluid dynamics	GDC	Gadolinium-doped ceria
FMEA	Failure modes and effects analysis	GDE	Gas diffusion electrode
<sup>19</sup> FNMR	<sup>19</sup> Fluorine nuclear magnetic resonance	GDL	Gas diffusion layer
FNR	Ferredoxin NADP+ oxidoreductase	GDM	Gas diffusion media
		GDS	Galvanodynamic scan

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Ge	Germanium	H <sub>2</sub> O <sub>2</sub>	Hydrogen peroxide
Gen I	First generation	H <sub>2</sub> S	Hydrogen sulfide
GES	Giner Electrochemical Systems, LLC	H <sub>2</sub> SO <sub>4</sub>	Sulfuric acid
GGA	Generalized gradient approximation	H <sub>3</sub> PO <sub>4</sub>	Phosphoric acid
GGA+U-SP	Generalized gradient approximation with Hubbard-type interaction parameter and spin polarized approach	HAADF	High-angle annular dark-field
GGE, gge	Gasoline gallon equivalent	HAADF-STEM	High angle annular dark field scanning transmission electron microscopy
GH <sub>2</sub>	Gaseous hydrogen	HAMMER	Hazardous Materials Management and Emergency Response
GHG	Greenhouse gas	HARC	Houston Advanced Research Center
GHSV	Gas hourly space velocity	HATCI	Hyundai-KIA America Technical Center Inc.
GIS	Geographic information system	HAVO	Hawaii Volcanoes National Park
GJ	Gigajoule(s)	HAZ	Heat affected zone
g/kW	Gram(s) per kilowatt	HAZID	Hazard identification analysis
GLAD	Glancing angle deposition	HAZOP	Hazards and operational safety analysis, hazards and operability analysis
gm	Gram(s)	HBr	Hydrogen bromide
GM	General Motors, Gifford McMahon	HCG	Hydrogen Coordinating Group
gm/day	Gram(s) per day	HCGB	Hydrocarbon-based guanidine base
g/min	Gram(s) per minute	HCl, HCL	Hydrochloric acid, hydrogen chloride
GNF	Graphite nanofiber	HClO <sub>4</sub>	Perchloric acid
GO	Gate opening, graphene oxide	HCO <sub>3</sub> <sup>-</sup>	Bicarbonate
GPa	Gigapascal(s)	hcp	Hexagonal close-packing
GPC	Gel permeation chromatography	HC&S	Hawaiian Commercial and Sugar Company
GPS	Global positioning system	HD	Deuterium hydride
GRC	Glass-reinforced concrete	HDF	Hydrogen dispensing facility
GREET	Greenhouse gases, Regulated Emissions and Energy use in Transportation model	HDPE	High-density polyethylene
GRPE	Working Party on Pollution and Energy	HDS	Hydrogen desulfurization
g/s	Grams per second	HDSAM	Hydrogen Delivery Scenario Analysis Model
GTI	Gas Technology Institute	He	Helium
GTR	Global Technical Regulations	HE	Hydrogen embrittlement
GUI	Graphical user interface	HEI	HyPerComp Engineering, Inc.
GV	Gasoline vehicle	HEMA	2-hydroxyethyl methacrylate
GWe	Gigawatt(s) electric	HEPA	High efficiency particulate air filter
h	Hour(s)	HER	Hydrogen evolution reaction
ΔH	Enthalpy of reaction, enthalpy of hydrogenation	HEV	Hybrid electric vehicle
ΔH <sub>f</sub> <sup>o</sup>	standard heat of formation	HEX	Heat exchanger
H	Hydrogen	Hf	Hafnium
H+	Proton	HF	Hydrofluorhydric acid, hydrogen fluoride, Hartree Fock
H <sup>-</sup>	Hydride	HFB	Hexafluorobenzene
H <sub>2</sub>	Diatomic hydrogen	HFC	Hydrogen fuel cell
H2A	Hydrogen Analysis project sponsored by DOE	HFCIT	Hydrogen, Fuel Cells and Infrastructure Technologies Program
H <sub>2</sub> -FCS	Stationary fuel cell system designs that co-produce hydrogen	HFCT	Hydrogen and fuel cell technology
H2-ICE, H <sub>2</sub> ICE	Hydrogen internal combustion engine		
H <sub>2</sub> O	Water		



HFCTF	Hawaii Fuel Cell Test Facility	HSMCoE	Hydrogen Storage Material Center of Excellence
HFCV	Hydrogen fuel cell vehicle		
HFI	Hydrogen Fuel Initiative	HSO <sub>4</sub>	Bisulfate anion
HFP	Hexafluoropropylene	HSRP	Hydrogen Safety Review Panel
HFR	High-frequency resistance	HSSIM	Hydrogen Storage SIMulator
HFS	Hydrogen fueling station	HT	High-temperature
HFV	Hydrogen-fueled vehicle	HTAC	Hydrogen and Fuel Cell Technical Advisory Committee
HHR	Hydrogen home refueler		
HHV	Higher heating value	HTM	Hydrogen transport membrane
HI	Hydrogen iodide	HTMWG	High Temperature Membrane Working Group
HIA	Hydrogen-induced amorphization, Hydrogen Implementing Agreement	HTS	High-temperature shift, high-throughput screening
HIC	Hydrogen-induced cracking	HTWGS	High-temperature water-gas shift
HMC	Hyundai Motor Company	HU	Heat utilization
HNEI	Hawaii Natural Energy Institute	H <sub>upd</sub>	Hydrogen underpotential deposition
HNO <sub>3</sub>	Nitric acid	HWFET	Highway Fuel Economy Test
HOMO	Highest occupied molecular orbital	HX	Heat exchanger
HOPG	Highly-ordered pyrolytic graphite	HyARC	Hydrogen Analysis Resource Center
HOR	Hydrogen oxidation reaction	HyDRA	Hydrogen Demand and Resource Analysis
hp	Horsepower		
HP	High-pressure	HyQRA	Hydrogen quantitative risk assessment
HPA	Heteropoly acid	HyTEx	Hydrogen Technical Experimental (database)
HPC	Highly porous carbon		
HPE	Hybrid photoelectrode	Hz	Hertz
H-PEMFC	hydrogen polymer electrolyte membrane fuel cell	i	Current density (mA/cm <sup>2</sup> )
		I	Current
HPIT	Hydrogen powered industrial trucks	I <sub>2</sub>	Diatomic iodine
HPLC	High performance liquid chromatography	IC	Internal combustion
HPPS	<i>N,N</i> -diisopropylethylammonium 2,2-bis( <i>p</i> -hydroxyphenyl) pentafluoropropanesulfonate	ICC	International Code Council
		ICE	Internal combustion engine
HPRD	Hydrogen pressure relief device	ICEV	Internal combustion engine vehicle
hr	Hour(s)	ICP	Inductively coupled plasma
HRA	Home Refueling Appliance	ICP-MS	Inductively coupled plasma mass spectrometry
HREELS	High resolution electron energy loss spectroscopy		
HRTEM	High-resolution transmission electron microscopy	ICR	Interfacial contact resistance
		ID	Inside diameter
HRXRT	High-resolution X-ray tomography	IEA	International Energy Agency
HS	Hydrogen sorption	IEA-HIA	International Energy Agency Hydrogen Implementing Agreement
HSC	Database name derived from the letters for enthalpy, entropy and heat capacity	IEC	Ion exchange capacity
		IEEE	Institute of Electrical and Electronics Engineers, Inc.
HSCoE	Hydrogen Sorption Center of Excellence	IFC	International Fire Code
HSDC	Hydrogen Secure Data Center	IFF	Integrated flow field
HSECoE	Hydrogen Storage Engineering Center of Excellence	IGCC	Integrated gasification combined cycle
HSM	Hydrogen storage material, hydrogen storage module	IHPV	Internally heated high-pressure vessel
		IL	Ionic liquid

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In	Indium	kA/m <sup>2</sup>	Kilo-ampere(s) per square meter
In., in	Inch	kb	Kilo-base pair, a unit of measurement used in genetics equal to 1,000 nucleotides
in <sup>2</sup>	Square inch		
InP	Indium phosphorus	KBr	Potassium bromide
INS	Inelastic neutron scattering	kcal	Kilocalorie(s)
IOS	Intelligent Optical Systems, Inc.	kcal/mol	Kilocalorie(s) per mole
IP	Intellectual property	KeV	Kilo electron volt(s)
IPA	Isopropyl alcohol	kg	Kilogram(s)
IPCC	Intergovernmental Panel on Climate Change	kg/d	Kilogram(s) per day
IPCE	Incident photon conversion to electrons, incident photon conversion efficiency	kg/hr	Kilogram(s) per hour
IPHE	International Partnership for the Hydrogen Economy	kg/m <sup>3</sup>	Kilogram(s) per cubic meter
IPTG	Isopropyl β-D-1-thiogalactopyranoside	KH	Potassium hydride
iR	Internal resistance, voltage loss due to resistance	kHz	Kilohertz
Ir	Iridium	KIA	Kia Motor Company
IR	Infrared	kJ	Kilojoule(s)
IRMOF	Isorecticular metal organic framework	K <sub>JIC</sub>	Fracture toughness
IrO <sub>x</sub>	Iridium oxide	kJ/mol	Kilojoule(s) per mole
IRR	Internal rate of return	km	Kilometer(s)
ISO	International Organization for Standardization	KMC	Kinetic Monte Carlo, Kilauea Military Camp, Kia Motors Corporation
ITM	Ion transport membrane	KOH	Potassium hydroxide
ITO	Indium tin oxide	kPa	Kilopascal(s)
ITP	Indium tin phosphate	kph	Kilometer(s) per hour
IV	Current-voltage	ksi	1,000 pound-force per square inch
IWG	Interagency Working Group	Kth	Fracture toughness threshold
J	Current, Joule(s)	kT/y	Kiloton(s) per year
JFK	John F. Kennedy (airport)	kW	Kilowatt(s)
JMFC	Johnson-Matthey Fuel Cells, Inc.	kW <sub>e</sub>	Kilowatt(s) electric
JNAIST	Japanese National Institute of Advanced Industrial Science and Technology	kWh	Kilowatt-hour(s)
JPL	Jet Propulsion Laboratory	kWh/kg	Kilowatt-hour(s) per kilogram
JRC	Joint Research Centre	kWh/L	Kilowatt-hour(s) per liter
J-V	Current density-voltage	kW/kg	Kilowatt(s) per kilogram
K	Sievert's constant, ml/[cm <sup>2</sup> -min-atm <sup>1/2</sup> ]	kWt	Kilowatt(s) thermal
K	Kelvin, absolute temperature	L, l	Liter(s)
K	Potassium	La	Lanthanum
K <sub>TH</sub>	Fracture toughness measured in hydrogen gas	LA	Los Angeles
K <sub>TH</sub>	Hydrogen-assisted crack growth threshold	LA-92	Los Angeles dynamometer driving cycle
kÅ	1,000 angstroms	LACVP	Chemistry basis set
KAERI	Korea Atomic Energy Research Institute	λ	Lambda, hydration number
KAIST	Korea Advanced Institute of Science and Technology	LANL	Los Alamos National Laboratory
		LAO	Lanthanum-modified alumina
		LAX	Los Angeles International Airport
		lb	Pound(s)
		LBM	Lattice Boltzmann method
		lbmol	Pound-mole(s)
		LBNL	Lawrence Berkeley National Laboratory



LC	Liquid carrier	LSX	Low-silica type-X
LCA	Life cycle assessment	LT	Low-temperature
LCH <sub>2</sub>	Hydrogenated liquid carrier, liquid to compressed hydrogen	LTDMS	Laser induced thermal desorption mass spectrometry
LCOE	Levelized cost of energy	LTM	Late-transition-metal
L/D	Length to diameter ratio	LUMO	Lowest unoccupied molecular orbital
L-DSM <sup>TM</sup>	Laser-drilled dimensionally stable membrane	m	Meter(s)
LDV	Light-duty vehicle	M	Mole, molar
LED	Light emitting diode	M	Million
LFG	Landfill gas	m <sup>2</sup>	Square meter(s)
LFL	Lower flammability limit	m <sup>2</sup> /g	Square meter(s) per gram
LFM	Load-following mode	m <sup>2</sup> /s	Square meter(s) per second
L/h, l/h	Liter(s) per hour	m <sup>3</sup>	Cubic meter(s)
LH <sub>2</sub> , LH <sub>2</sub>	Liquid hydrogen	mA	MilliAmps (s)
LHC	Light-harvesting chlorophyll	MA	Mass activity, methyl acrylate
LHS	Lawrence Hall of Science	μA	Micro ampere(s)
LHSV	Liquid hourly space velocity, h <sup>-1</sup>	mA/cm <sup>2</sup>	Milliamp(s) per square centimeter
LHV	Lower heating value	μA/cm <sup>2</sup>	Micro ampere(s) per square centimeter
Li	Lithium	M-AB	Metal ammonia-borane
Li-AB	Lithium amidoborane, Li-NH <sub>2</sub> -BH <sub>3</sub>	MAB, M-AB	Metal amidoboranes
LiBH <sub>4</sub>	Lithium borohydride	MAS	Magic angle spinning
LIBS	Laser-induced breakdown spectroscopy	MAS <sup>11</sup> B-NMR	Magic angle spinning boron-11 nuclear magnetic resonance spectroscopy
LiH	Lithium hydride	MAS-NMR	Magic angle spinning nuclear magnetic resonance
LIM	Liquid injection molding, liquid injection moldable	MB	Megabyte
LLC	Limited Liability Company, lessons learned corner	MBE	Molecular beam epitaxy
LLNL	Lawrence Livermore National Laboratory	MBRC	Miles between roadcall
L/min, l/min	Liter(s) per minute	MC	Monte Carlo
LN <sub>2</sub>	Liquid nitrogen	mC <sup>2</sup>	Multi-component composite (membrane)
LNG	Liquefied natural gas	mC-cm <sup>-2</sup>	MilliCoulomb(s) per square centimeter
LOD	Limit of detection	MCEL	Millenium Cell, Inc.
LOI	Letter of interest	MCFC	Molten carbonate fuel cell
LPG	Liquefied petroleum gas	mCHP	micro-CHP
LPM	Liters per minute	MDE	Mid-duty electric
LPR	Liquid-phase reforming	MEA	Membrane electrode assembly
LRS	Laser raman spectroscopy	MEC	Microbial electrolysis cell, minimum explosive concentration
LSC	Lanthanum strontium cobalt oxide, (La, Sr)CoO <sub>3</sub> , strontium-doped lanthanum cobaltite, La <sub>0.8</sub> Sr <sub>0.2</sub> CoO <sub>3+δ</sub>	MeOH	Methanol
LSCF	Lanthanum strontium cobalt iron oxide, (La, Sr)(Co, Fe)O <sub>3</sub>	MEOP	Maximum expected operating pressure
LSM	Lanthanum strontium manganese	meq	Milliequivalents
LSMO	Lanthanum strontium manganese oxide, (La, Sr)MnO <sub>3</sub> , strontium-doped lanthanum manganite, La <sub>0.8</sub> Sr <sub>0.2</sub> MnO <sub>3+δ</sub>	meq/g	Milliequivalents/gram
		MeV	Mega electron volt
		mf	Mass fraction
		MFC	Microbial fuel cell, mass flow controller
		MFI	A zeolite structure code
		mg	Milligram(s)

### XIII. Acronyms, Abbreviations and Definitions

Mg	Megagram(s)	mph	Mile(s) per hour
µg	Microgram(s)	MPHSS	Medium Pressure Hydrogen Storage Solution
MgCl <sub>2</sub>	Magnesium chloride	MPL	Microporous layer
mg/cm <sup>2</sup>	Milligram(s) per square centimeter	MPMC	Massively Parallel Monte Carlo
MgH <sub>2</sub>	Magnesium hydride	MPPT	Maximum power point tracker
MgO	Magnesium oxide	MR	Membrane reactor
Mg(OH) <sub>2</sub>	Magnesium hydroxide	MRC	Mitsubishi Rayon Co.
mgPt/cm <sup>2</sup>	Milligram(s) of platinum per square centimeter	ms	Millisecond(s)
MH, M-H	Metal hydride	MS	Mass spectroscopy, mass spectrometry
MHC	Metal hydride-based compressor	mS/cm	Milli-Siemen(s) per centimeter
MHCoE	Metal Hydride Center of Excellence	MSM	Macro-System Model
MHz	Megahertz	MSR	Membrane steam reformer
mi	Mile(s)	MSRI	Materials and Systems Research, Inc.
MIE	Minimum ignition energy	MSU	Montana State University
MIEC	Mixed ionic and electronic conduction	MSW	Municipal solid waste
mi/kg	Mile(s) per kilogram	MT	Mass transport, microturbine
mil	Millimeter(s)	MTI	Mechanical Technology, Inc.
min	Minute(s)	mtorr	Millitorr
MIT	Massachusetts Institute of Technology	µV	Micro volt(s)
MiTi <sup>®</sup>	Mohawk Innovative Technologies Inc.	mV	Millivolt(s)
MJ	Megajoule(s)	MV	Methyl viologen
mL, ml	Milliliter(s)	mW	Milliwatt(s)
ML	Monolayer	MW	Megawatt(s), molecular weight
µc-Si	Microcrystalline silicon	mΩ	Milli-ohm(s)
µm	Micrometer(s), micron(s)	MΩ	Mega-ohm(s)
µM	Micromolar	mΩ/cm <sup>2</sup>	Milli-ohm(s) per square centimeter
mm	Millimeter(s)	µΩ-cm <sup>2</sup>	Micro-ohm(s)-square centimeter
mM	Millimolar	mW/cm <sup>2</sup>	Milliwatt(s) per square centimeter
MMBtu	Million British thermal units	MWCNT	Multiple-wall carbon nanotube
MMOF	Microporous metal-organic framework	MWe	Megawatt(s) electric
mmol	Millimole(s)	MWh	Megawatt-hour(s)
µmol	Micromole(s)	MWNT	Multi-wall carbon nanotube
Mn	Manganese	MWOE	Midwest Optoelectronics, LLC
Mn <sub>2</sub> O <sub>3</sub>	Manganese oxide	MWth	Megawatt(s) thermal
M-N-H	Amide/imide	MYPP	Multi-Year Program Plan (the FCT Program's Multi-Year Research, Development and Demonstration Plan)
MnO	Manganese oxide	MYRDD, MYRD&DP	Multi-Year Research, Development and Demonstration Plan
Mo	Molybdenum	N	Nitrogen atom, Newton (unit of force)
MO	Molecular orbital, metal oxide	N112	Nafion <sup>®</sup> 1,100 equivalent weight, 2 millimeter thick membrane
MOC	Management of Change	N <sub>2</sub>	Diatomic nitrogen
MOF	Metal-organic framework	N <sub>2</sub> O	Nitrous oxide
mol	Mole(s)	Na	Sodium
mol%	Mole percent		
mol/min	Mole(s) per minute		
MOR	Methanol oxidation reaction		
MPa	Megapascal(s)		
MPG, mpg	Mile(s) per gallon		

Na <sub>2</sub> S	Sodium sulfide	Ni	Nickel
NaAlH <sub>4</sub>	Sodium aluminum hydride, sodium tetrahydroaluminate, sodium alanate	NILS	Normal interstitial lattice sites
NaBH <sub>4</sub>	Sodium borohydride	NiMH	Nickel metal hydride
NaBO <sub>2</sub>	Sodium metaborate	NIST	National Institute of Standards and Technology
NACE	National Association of Corrosion Engineers	NL	Normal liter(s)
NaCl	Sodium chloride	nm	Nanometer(s)
NADP	Nicotinamide adenine dinucleotide phosphate	Nm <sup>3</sup>	Normal cubic meter(s)
NADPH	Nicotinamide adenine dinucleotide phosphate	NMHC	Non-methane hydrocarbons
Nafion <sup>®</sup>	Registered Trademark of E.I. DuPont de Nemours; sulfonated tetrafluoroethylene based fluoropolymer-copolymer	NMOC	Non-methane organic carbons
NaH	Sodium hydride	nmol	Nanomole(s)
NaOH	Sodium hydroxide	NMR	Nuclear magnetic resonance
NAS	National Academy of Sciences	NMSU	New Mexico State University
NASA	National Aeronautics and Space Administration	NNIF	NIST neutron imaging facility
Nb	Niobium	NO <sub>2</sub>	Nitric oxide
N/cm <sup>2</sup>	Newton(s) per square centimeter	NOA	Norland Optical Adhesive
NCN	Nano capillary network	nOB	N-octyl benzene
NCNR	NIST Center for Neutron Research	NOx	Oxides of nitrogen
NCSL	National Conference of State Legislators	NP	Nanoparticle
NDA	Non-disclosure agreement	NPIC	Nanoporous carbon
nDDB	N-dodecyl benzene	NPM	Non-precious metal
NDE	Non-destructive examination	NPS	National Park Service
NDTE	Non-destructive testing and evaluation	NPT	Normal pressure and temperature
NEED	National Energy Education Development Project	NRC	National Academy of Sciences
NEPA	National Environmental Policy Act	NREL	National Renewable Energy Laboratory
NETL	National Energy Technology Laboratory	NSF	National Science Foundation
NFC	Near-frictionless coating	NST	New stress test
NFCRC	National Fuel Cell Research Center	NSTF	Nano-structured thin-film
NFM	Nanoporous framework material	NSTFC	Nano-structured thin film catalyst
Nfn-Pt/C	Nafion <sup>®</sup> -loaded Pt/C	NT	Nanotube
NFPA	National Fire Protection Association	NV	Neutron vibrational
NFS	Nano-framework structured	NVS	Neutron vibrational spectroscopy
NG	Natural gas	NYC	New York City
NGNP	Next Generation Nuclear Plant	NYSERDA	New York State Energy Research and Development Authority
NG-SR	Natural gas steam reforming	O	Oxygen
NH <sub>3</sub>	Ammonia	O <sub>2</sub>	Diatom oxygen
NHA	National Hydrogen Association	O/C	Oxygen-to-carbon ratio
NHE	Normal hydrogen electrode	OCP	Open circuit potential
NHTSA	National Highway Traffic Safety Administration of the U.S. Department of Transportation	OCSD	Orange County Sanitation District
		OCV	Open-circuit voltage
		o.d.,OD	Outer diameter
		OEM	Original equipment manufacturer
		OER	Oxygen evolution reaction
		OGMC	Ordered graphitic mesoporous carbon
		OH <sup>·</sup>	Hydroxyl radical
		Ω	Ohm(s)

### XIII. Acronyms, Abbreviations and Definitions

$\Omega\text{cm}^2$	Ohm(s)-square centimeter	PE	Polyelectrolyte, polyethylene, proton conductor
O&M	Operation and maintenance	PEC	Photoelectrochemical, photoelectrocatalyst, photoelectrochemical cell
OMC	Ordered mesoporous carbon	PECVD	Plasma-enhanced chemical vapor deposition
O/O	Oxygen to oxygen	PEEK	Polyether ether ether ketone
ORF	Opening Reading Frame indicating the occurrence of a protein coding region in the DNA sequence	PEFC	Polymer electrolyte fuel cell, proton exchange fuel cell
ORNL	Oak Ridge National Laboratory	PEG	Polyethylene glycol
ORNL-HTML	Oak Ridge National Laboratory High Temperature Materials Laboratory	PEGMEMA	Monomethoxypoly(ethyleneglycol) methacrylate
ORR	Oxygen reduction reaction	PEGS	Prototype electrostatic ground state
OSC	Orlando Science Center, oxygen storage capability	PEI	Polyetherimide, polyethylene imine
OSHA	U.S. Occupational Safety and Health Administration	PEKK	Poly (ether ketone ketone)
OSM	Optical scatterfield microscopy	PEM	Proton exchange membrane, polymer electrolyte membrane
OSU	Ohio State University	PEMFC	Polymer electrolyte membrane fuel cell, proton exchange membrane fuel cell
OTM	Oxygen transport membrane	PEO	Poly(ethylene oxide)
$\Delta P$	Pressure drop, pressure change	PES	Polyether sulfone
P	Phosphorus, pressure	PFA	Perfluoroalkoxy (a type of fluoropolymer), polyfurfuryl alcohol
Pa	Pascal(s)	PFC	Polymer electrolyte membrane fuel cell
PA	Polyamide	PFD	Process flow diagram
PAD	Polymer assisted deposition	PFGB	Perfluorinated guanidine base
PAES	Poly(arylene-ether-sulfone)	PFPO-PSS	Poly(perfluoropropylene oxide)-b-poly(styrene sulfonate)
PAFC	Phosphoric acid fuel cell	PFSA	Perfluorinated sulfonic acid, perfluorosulfonic acid, poly(fluorosulfonic acid)
PAN	Peroxyacetyl nitrate	PGM	Precious group metal, platinum group metal
PANI	Polyaniline	<i>p</i> -H <sub>2</sub>	Para-hydrogen
PA/PBI	Phosphoric-acid-doped polybenzimidazole	pH	Power of the hydronium ion
PAW	Projector augmented wave	PHEV	Plug-in hybrid vehicle
Pb	Lead	PI	Principal investigator, polyimide
PBI	Polybenzimidazole	PIL, pIL	Protic ionic liquid
PBPDSA	poly(biphenylene disulfonic acid)	PIM, pIM	Protic ionic membrane
P-C	Pressure-composition	PLC	Programmable logic controller
PCI	Pressure-composition isotherm	PLLA	Poly-L-lactic acid
PCL	Polycaprolactone	PM	Particulate matter
PCM	Power control module	PNNL	Pacific Northwest National Laboratory
PCR	Polymerase chain reaction	pO <sub>2</sub>	Oxygen partial pressure
PCT, P-C-T	Pressure-concentration-temperature	POC	Proof of concept
PCTFE	Polychlorotrifluoroethylene	POF	Polymeric-organic frameworks, porous organic framework
Pd	Palladium	POM	Polyoxometallate
PdAg	Palladium-silver alloy		
PdCu	Palladium-copper alloy		
PdCuTM	Palladium copper transition metal		
Pd-CR	Palladium-based chemical resistor		
PDF	Probability density function, pair distribution function		
PDI	Polydispersity index		

POP	Porous organic polymers	PVT, P-V-T	Pressure-volume-temperature
POSS	Polyhedral oligomeric silsesquioxane, Petroleum Offshore Survey Support	PWG	Pipeline Working Group
POX	Partial oxidation	PXRD	Powder X-ray diffraction
PPA	polyphosphoric acid	Q	Neutron momentum transfer
ppb	Part(s) per billion	Q1, Q2, Q3, Q4	Quarters of the fiscal year
ppbv	Part(s) per billion by volume	QC	Quality control
PPDSA	Poly (p-phenylene disulfonic acid)	QCM	Quartz crystal microbalance
PPI	Pore(s) per inch	QLRA	Qualitative risk analysis
ppm, PPM	Part(s) per million	QMC	Quantum Monte Carlo
ppmv	Part(s) per million by volume	QNS	Quasielastic neutron scattering
ppmw	Part(s) per million by weight	QRA	Quantitative risk assessment
PPO	Phenyl phosphine oxide	R	Universal or ideal gas constant, 8.314472 J · K <sup>-1</sup> · mol <sup>-1</sup>
PPS	Polyphenylene sulfide	RCD	Rated current density
PPSA	Partial pressure swing adsorption	R&D	Research and development
PPSU	Polyphenylsulfone	RD&D, R,D&D	Research, development & demonstration
PPy	Polypyrrole	RDE	Rotating disk electrode
PSA	Pressure swing adsorption, adsorber	Re	Rhenium
PSD	Particle size distribution, pore size distribution	RF, rf	Radio frequency
PSEPVE	Perfluoro (4-methyl-3,6-dioxaoct-7-ene) sulfonyl fluoride	RFP	Request for proposals
psi, PSI	Pound(s) per square inch	RGA	Residual gas analyzer (analysis)
psia	Pound(s) per square inch absolute	Rh	Rhodium
psid	Pound(s) per square inch differential	RH	Relative humidity
psig, PSIG	Pound(s) per square inch gauge	RHE	Reference hydrogen electrode; reversible hydrogen electrode
PSOFC	Planar solid oxide fuel cell	RNA	Ribo nucleic acid
PSS	Porous stainless steel, potentiostatic scan	ROMP	Ring Opening Metathesis Polymerization
PSU	Pennsylvania State University	rpm	Revolution(s) per minute
Pt	Platinum	RPSA	Rapic pressure swing adsorption
Pt/AX-21	Pt-doped microporous carbon AX-21	RRC	Regional resource center
PTFE	Teflon <sup>®</sup> – poly-tetrafluoroethylene	RRDE	Rotating ring disc electrode
PtO <sub>2</sub>	Platinum dioxide	RSOFC	Reversible solid oxide fuel cell
PtRu	Platinum ruthenium	RST	Rapid screening test
Pt-SWNH	Platinum decorated single-walled nanohorns	RT	Room temperature
PTTPP	Poly-tetrakis(3,5-dithiophen-2-ylphenyl)-porphyrin	Ru	Ruthenium
PTW	Pump-to-wheels	s	Second(s)
PV	Photovoltaic	S	Siemen(s)
PVA	Polyvinyl alcohol	S	Sulfur
PVC	Polyvinyl chloride	SA	Surface area
PVD	Physical vapor deposition	SA	Sulfur-ammonia thermochemical water-splitting cycle; system architect
PVDC	Poly-vinylidene dichloride	SAC	Site acquisition
PVDF	Polyvinylidene fluoride	SAE	Society of Automotive Engineers
PVP	Polyvinylpyrrolidone	SAFC	Solid acid fuel cell
PVPP	Polyvinyl pyridinium phosphate	SAM	Scanning Auger microscopy
		SANS	Small angle neutron scattering
		SAXS	Small angle X-ray scattering

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SBAB	Sec-butylamineborane	SLAC	Stanford Linear Accelerator Center
S <sub>BET</sub>	BET specific surface area	SLD	Simplified local density
SBH	Sodium borohydride	SLPH	Standard liter(s) per hour
SBIR	Small Business Innovation Research	SLPM, slpm, slm, sL/min	Standard liter(s) per minute
SBR	Styrene-butadiene rubber	SLT	Strontium-doped lanthanum titanate
SBU	Secondary building unit	SMMM	Supported molten metal membrane
Sc	Scandium	SMORS	Sub-scale molded o-ring seal
S/C	Steam to carbon ratio	SMR	Steam methane reformer, steam methane reforming
sccm, SCCM	Standard cubic centimeter(s) per minute	SMR-ECM	Steam methane reformer with electrochemical purifier
SCE	Saturated calomel electrode	SMR-PSA	Steam methane reformer with pressure swing adsorption
SCF, scf	Standard cubic feet, supercritical fluid	Sn	Tin
scfd	Standard cubic feet per day	SNL	Sandia National Laboratories
SCFH, scfh	Standard cubic feet per hour	SNLL	Sandia National Laboratories Livermore
SCFM	Standard cubic feet per minute	SnO	Tin oxide
S/cm	Siemen(s) per centimeter	SnO <sub>2</sub>	Tin oxide
SCOF	Single cell with open flowfield	SNTT	Spiral notch torsion test
SCPO	Staged catalytic partial oxidation	SO <sub>2</sub>	Sulfur dioxide
SCR	Selective catalytic reduction, semiconductor rectifier	SO <sub>3</sub>	Sulfur trioxide
SD	Standard deviation	SOC	State-of-charge
SDO	Standards development organization	SOEC	Solid oxide electrolysis cell, solid oxide electrolyzer cell
Se	Selenium	SOFC	Solid oxide fuel cell
sec	Second(s)	SOW	Statement of work
SEM	Scanning electron microscopy, scanning electron microscope	SOx	Oxides of sulfur
SENT	Single edge notch tension	sPAES	Sulfonated poly(arylene ether sulfone)
SEPUP	Science Education for Public Understanding Program	SPEEK	Sulfonated poly(ether ether ketone)
SERA	Scenario Evaluation, Regionalization and Analysis	SPEK	Sulfonated poly-etherketone-ketone
SERC	Schatz Energy Research Center	SPEKK	Sulfonated polyether(ether ketone ketone)
SFA	Sulfonic acid	SPEX	Type of milling machine
SFC	Stationary fuel cell	SPM	Scanning probe microscope
SFM	Sr <sub>2</sub> Fe <sub>1.5</sub> Mo <sub>0.5</sub> O <sub>6-8</sub>	sPOSS	sulfonated octaphenyl polyhedral oligomeric silsesquioxanes
SFTI	Sr <sub>0.1</sub> Fe <sub>0.9</sub> Ti <sub>0.10</sub> O <sub>x</sub>	sq. in.	Square inch(es)
SGD	Spontaneous galvanic displacement, system gravimetric density	Sr	Strontium
SGIP	Self Generation Incentive Program	SR	Steam reformer, steam reforming
SHE	Standard hydrogen electrode	SR-M	Steam reformer membrane
Si	Silicon	SRNL	Savannah River National Laboratory
Si <sup>3</sup> N <sup>4</sup>	Silicon nitride	SrO	Strontium oxide
SiC	Silicon carbide	SrTiO <sub>3</sub>	Strontium titanate, the proton conducting material
SiCN	Silicon carbonitride	SS	Stainless steel
SIMS	Secondary ion emission spectroscopy	SSA	Specific surface area
Si-NS	Silica nanosprings	SSAWG	Storage System Analysis Working Group
SiO <sub>2</sub>	Silicon dioxide		
sL	Standard liter (0°C, 1 atm)		



SSNMR	Solid-state nuclear magnetic resonance	tf-Si	Thin-film silicon
SSRL	Stanford Synchrotron Radiation Laboratory	TFSI	bis(Trifluoromethylsulfonyl)imide
SSRS	Solid-state reactive sintering	T <sub>g</sub>	Glass transition temperature
SSWAG	Storage System Working Analysis Group	Tg	Glass transition temperature
STCH	Solar Thermochemical Hydrogen	TG	Thermogravimetric, Theory Group
STEM	Scanning transmission electron microscopy, science, technology, engineering, and mathematics	TGA	Thermal gravimetric analysis, thermogravimetric analysis, thermogravimetric analyzer
STH	Solar-to-hydrogen	TGA-DSC	Thermo-gravimetric analysis-differential scanning calorimetry
STM	Scanning tunneling microscopy	TGA-MS	Thermogravimetric analysis-mass spectrometer
STMBMS	Simultaneous thermogravimetric modulated beam mass spectrometer	THC	Total hydrocarbons
STP	Standard temperature and pressure	THF	Tetrahydrofuran
STS	Scanning tunneling spectroscopy	Ti	Titanium
STTP	Shared Technology Transfer Project	TiCl <sub>3</sub>	Titanium trichloride
STTR	Small Business Technology Transfer	TiF <sub>3</sub>	Titanium trifluoride
S <sub>u</sub>	Ultimate tensile strength	TiH <sub>2</sub>	Titanium hydride
SUNY-ESF	State University New York Environmental Science Forestry	TiO <sub>2</sub>	Titanium dioxide (anatase)
SV	Space velocity	<i>Tla</i>	Truncated light-harvesting chlorophyll antenna
SWCNT	Single-walled carbon nanotube	<i>tla1</i>	Mutant of the Tla1 gene (GenBank Assession No. AF534570)
SWNH	Single-walled nanohorn	<i>tlaR</i>	Mutant of unknown gene with a truncated light-harvesting chlorophyll antenna
SWNT	Single-wall nanotube	<i>tlaX</i>	Mutant of unknown gene with a truncated light-harvesting chlorophyll antenna
SwRI <sup>®</sup>	Southwest Research Institute <sup>®</sup>	TM	Transition metal
S <sub>y</sub>	Yield strength	TMA	Trimethylamine, trimethylaluminum
t	Time	TMEDA	Tetramethylethane-1,2-diamine, N <sup>1</sup> ,N <sup>1</sup> ,N <sup>2</sup> ,N <sup>2</sup> -tetramethylethane-1,2-diamine
T	Temperature	TMG	Tetramethyl guanidine
T, t	Ton, tonne	TNT	Trinitrotoluene
TAG	Technical Advisory Group	TOC	Total organic content
TAL	Technology area lead	TOF	Turnover frequency
TAMU	Texas A&M University	TPA	Tripropylamine, temperature-programmed adsorption
TaON	Tantalum oxynitride	TPD	Tonne(s) per day, thermally programmed desorption, temperature-programmed desorption
TBD	To be determined	TPO	Temperature-programmed oxidation
TCO	Transparent conductive oxide	TPR	Temperature-programmed reduction
TCWSC	Thermochemical water splitting cycle	TRAIN	TrainingFinder Realtime Affiliate Network
Te	Tellurium	tr. oz.	Troy ounce
TEA	Triethylamine	TSA	Temperature swing adsorption
TEAA	Triethylamine alane adduct	TV	Test vehilce
TEAB	Tetraethyl ammonium borohydride		
TEDA	Triethylenediamine		
TEM	Transmission electron microscopy		
TEOM	Tapered element oscillating microbalance		
Tf	Trifluormethane sulfonate, triflate anion (CF <sub>3</sub> SO <sub>3</sub> <sup>-</sup> )		
TFA	Trifluoromethanesulfonic acid		
TFE	Tetrafluoroethylene		
TFF	Tangential flow filtration		

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UC	University of California	VB	Valence band
UCB	University of California, Berkeley	VBM	Valence band minimum
UCF	University of Central Florida	VC	Vanadium carbide
UCI	University of California, Irvine	VC	Vulcan carbon
UCLA	University of California, Los Angeles	VDC	Volts direct current
UCONN	University of Connecticut	vdW	van der Waals
UCSB	University of California, Santa Barbara	VHSV	Volumetric hourly space velocity
UDDS	Urban Dynamometer Driving Schedule	V-I	Voltage-current
UEL	Upper explosive limit	VIS	Visible light at 400-700 nm
UFL	Upper flammability limit	VMT	Vehicle miles travelled
UH	University of Hawaii	VNT	Variable nozzle turbine
UHP	Ultra-high purity	VOC	Volatile organic compound, voltage open circuit
ULSD	Ultra-low sulfur diesel	VOF	Volume of fluid
um	Micrometer(s)	vol	Volume
UM	University of Michigan	vol%	Volume percent
UMC	Unsaturated metal centers	$V_{\text{pore}}$	Total pore volume
UN	United Nations	VT	Virginia Tech
UNB	University of New Brunswick	VTNA	Volvo Trucks North America
UNCC	University of North Carolina at Charlotte	V/Vo	Dimensionless distance from the reactor inlet
UNLV	University of Nevada, Las Vegas	W	Tungsten, watt(s)
UNM	University of New Mexico	WAXD	Wide-angle X-ray diffraction
UNR	University of Nevada, Reno	WAXS	Wide-angle X-ray scattering
UPE	Ultra-high molecular weight polyethylene	WC	Tungsten carbon, tungsten carbide
URL	Uniform resource locator	W/cm <sup>2</sup>	Watt(s) per square centimeter
U.S.	United States	$W_e$	Watt(s) electric
USB	Universal serial bus	WFS	Web feature services
USC	University of South Carolina, University of Southern California	WG	Working group
USCAR	United States Council for Automotive Research, U.S. Cooperative Automotive Research	WG-12	Working Group 12
USFCC	United States Fuel Cell Council	WGS	Water-gas shift
USM	University of Southern Mississippi	WGSMR	Water-gas shift membrane reactor
UT	University of Toledo	WGSR	Water-gas shift reactor
UTC, UTC FC	United Technologies Corporation Fuel Cells	Wh	Watt-hour(s)
UTC	University of Tennessee, Chattanooga	W(H <sub>2</sub> )	Gravimetric hydrogen storage capacity
UTCP	UTC Power	W-h/kg	Watt-hour(s) per kilogram
UTRC	United Technologies Research Center	W-h/L, Wh/liter, Wh/L	Watt-hour(s) per liter
UV	Ultraviolet	WHSV	Weight hourly space velocity
UV-vis	Ultraviolet-visual	Wind2H2	Wind to hydrogen demonstration project
V	Vanadium, volt	W/kg	Watt(s) per kilogram
$V_{\text{mp}}$	Micropore volume	W/L, W/l	Watt(s) per liter
VA	Vinyl acetate	W/m-K, W/m.K, W/mK	Watt(s) per meter-Kelvin (unit of thermal conductivity)
VACNTs	Vertically aligned carbon nanotubes	WO <sub>3</sub>	Tungsten trioxide
VANTA	Vertically aligned nanotube arrays	Wppm	Weight part(s) per million
VASP	Vienna ab initio simulation package		

WRI	Western Research Institute	XPS-UPS	X-ray photoelectron-ultraviolet photoelectron spectroscopy
wt	Weight		
Wt	Watt(s) thermal	XRD	X-ray diffraction
wt%, wt. %	Weight percent (percent by weight)	XRF	X-ray fluorescence
WTP	Well-to-pump, Water Transport Plate	Y	Yttrium
WTT	Well-to-tank	yr, YR	Year
WTW	Well-to-wheels	YSZ	Yttria-stabilized zirconia
w/v	Weight by volume	Z	Atomic number
XAFS	X-ray absorption fine structure	ZEFC	Zero Emissions Fuel Cell and Hydrogen Laboratory
XANES	X-ray absorption near-edge spectroscopy	ZEV	Zero emission vehicle
XAS	X-ray absorption spectroscopy	ZIF	Zeolitic imidazolate framework
XC72	High-surface-area carbon support made by Cabot	ZMOF	Zeolite(-type) metal-organic framework
XES	X-ray emission spectroscopy	Zn	Zinc
XPS	X-ray photoelectron spectroscopy, X-ray photon spectroscopy, X-ray photoemission spectroscopy, X-ray photoluminescence spectroscopy	ZnO	Zinc oxide
		Zr	Zirconium
		ZrO <sub>2</sub>	Zirconium dioxide