# Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAI</td>
<td>Air-assisted injector (or injection)</td>
</tr>
<tr>
<td>AAM</td>
<td>Alliance of Automobile Manufacturers</td>
</tr>
<tr>
<td>AAPFI</td>
<td>Air-assisted port fuel injection</td>
</tr>
<tr>
<td>A/F</td>
<td>Air/fuel (ratio)</td>
</tr>
<tr>
<td>AFI</td>
<td>Air-forced injector (or injection)</td>
</tr>
<tr>
<td>AFPFI</td>
<td>Air-forced port fuel injection</td>
</tr>
<tr>
<td>AIGER</td>
<td>American Industry/Government Emissions Research</td>
</tr>
<tr>
<td>ALO$_4$</td>
<td>Aluminum tetraoxide</td>
</tr>
<tr>
<td>AQIRP</td>
<td>Auto/Oil Air Quality Improvement Research Program</td>
</tr>
<tr>
<td>ATDC</td>
<td>After or above top dead center (of piston travel)</td>
</tr>
<tr>
<td>ATPZEV</td>
<td>Advanced technology partial zero emissions vehicle (Toyota)</td>
</tr>
<tr>
<td>BDC</td>
<td>Bottom dead center (of piston travel)</td>
</tr>
<tr>
<td>BMD</td>
<td>Bag mini-diluter</td>
</tr>
<tr>
<td>BMEP</td>
<td>Brake mean effective pressure</td>
</tr>
<tr>
<td>BTDC</td>
<td>Before or below top dead center (of piston travel)</td>
</tr>
<tr>
<td>CAD</td>
<td>Crank angle degree</td>
</tr>
<tr>
<td>CARB</td>
<td>California Air Resources Board</td>
</tr>
<tr>
<td>CAT</td>
<td>Catalyst</td>
</tr>
<tr>
<td>CC</td>
<td>Close-coupled (catalyst)</td>
</tr>
<tr>
<td>CCD</td>
<td>Charge-coupled device</td>
</tr>
<tr>
<td>CCM</td>
<td>Comprehensive component monitor</td>
</tr>
<tr>
<td>CE</td>
<td>Conversion efficiency (of hydrocarbon)</td>
</tr>
<tr>
<td>CEC</td>
<td>Coordinating European Council</td>
</tr>
<tr>
<td>CFI</td>
<td>Central fuel injection</td>
</tr>
<tr>
<td>CFO</td>
<td>Critical flow orifice</td>
</tr>
<tr>
<td>CFR</td>
<td>U.S. Code of Federal Regulations; also Corporate Fuels Research</td>
</tr>
<tr>
<td>CFV</td>
<td>Critical flow venturi</td>
</tr>
<tr>
<td>CHSS</td>
<td>Coolant heat storage system</td>
</tr>
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### Near-Zero-Emission Gasoline-Powered Vehicles

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<tr>
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<tr>
<td>CICT</td>
<td>Color imaging capturing technique</td>
</tr>
<tr>
<td>CLA</td>
<td>Chemiluminescence analyzer (or detector)</td>
</tr>
<tr>
<td>CMCV</td>
<td>Charge motion control valve</td>
</tr>
<tr>
<td>COP</td>
<td>Crossover point (NOx)</td>
</tr>
<tr>
<td>COV</td>
<td>Coefficient of variation</td>
</tr>
<tr>
<td>CP2-RFG</td>
<td>California Phase II reformulated gasoline</td>
</tr>
<tr>
<td>CRC</td>
<td>Coordinating Research Council</td>
</tr>
<tr>
<td>CVI</td>
<td>Closed-valve injection</td>
</tr>
<tr>
<td>CVS</td>
<td>Constant volume sampler</td>
</tr>
<tr>
<td>CV-SCV</td>
<td>Continuously variable swirl control valve</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Letter</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Diffusion coefficient (cm²/sec)</td>
</tr>
<tr>
<td>DAR</td>
<td>Dilution air refinement (system)</td>
</tr>
<tr>
<td>DF</td>
<td>Dilution factor</td>
</tr>
<tr>
<td>DI</td>
<td>Driveability index; ( DI = 1.5 \times T_{10} + 3 \times T_{50} + T_{90} ); temperatures in degrees Fahrenheit (°F); \textit{also} Direct injection</td>
</tr>
<tr>
<td>DISI</td>
<td>Direct injection spark ignition</td>
</tr>
<tr>
<td>DVE</td>
<td>Direct vehicle exhaust</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>ECM</td>
<td>Engine control module</td>
</tr>
<tr>
<td>ECU</td>
<td>Engine control unit</td>
</tr>
<tr>
<td>EDI</td>
<td>Evaporation driveability index</td>
</tr>
<tr>
<td>EGI</td>
<td>Exhaust gas ignition</td>
</tr>
<tr>
<td>EGR</td>
<td>Exhaust gas recirculation</td>
</tr>
<tr>
<td>EHC</td>
<td>Electrically heated catalyst</td>
</tr>
<tr>
<td>EOBD</td>
<td>European onboard diagnostics (standards)</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>ETBE</td>
<td>Ethyl-tertiary butyl ether</td>
</tr>
<tr>
<td>EVC</td>
<td>Exhaust valve closing (timing)</td>
</tr>
<tr>
<td>EVO</td>
<td>Exhaust valve opening (timing)</td>
</tr>
<tr>
<td>E_{XX}</td>
<td>Percent evaporated at temperature XX</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>FFID</td>
<td>Fast-response flame ionization detector; \textit{also} FRFID</td>
</tr>
<tr>
<td>FIA</td>
<td>Flame ionization analyzer</td>
</tr>
<tr>
<td>FID</td>
<td>Flame ionization detection (or detector)</td>
</tr>
<tr>
<td>FKM</td>
<td>Fluorocarbon elastomer</td>
</tr>
<tr>
<td>FTP</td>
<td>U.S. Federal Test Procedure; \textit{also} FTP-75</td>
</tr>
<tr>
<td>Acronyms</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
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</tr>
<tr>
<td>GC</td>
<td>Gas chromatography</td>
</tr>
<tr>
<td>GDI</td>
<td>Gasoline direct injection (engine)</td>
</tr>
<tr>
<td>GIMEP</td>
<td>Gross indicated mean effective pressure</td>
</tr>
<tr>
<td>GRNN</td>
<td>Generalized regression neutral network</td>
</tr>
<tr>
<td>GSA</td>
<td>Geometric surface area</td>
</tr>
<tr>
<td>H</td>
<td>Henry’s constant (kPa)</td>
</tr>
<tr>
<td>H/C</td>
<td>Hydrogen-to-oxygen ratio (of fuel)</td>
</tr>
<tr>
<td>HDPE</td>
<td>High-density polyethylene</td>
</tr>
<tr>
<td>HEGO</td>
<td>Heated exhaust gas oxygen (sensor)</td>
</tr>
<tr>
<td>HEV</td>
<td>Hybrid electric vehicle</td>
</tr>
<tr>
<td>HPIV</td>
<td>Holographic particle image velocimetry</td>
</tr>
<tr>
<td>I4</td>
<td>Inline four-cylinder (engine)</td>
</tr>
<tr>
<td>IACV</td>
<td>Intake air control valve</td>
</tr>
<tr>
<td>ICV</td>
<td>Inlet check valve</td>
</tr>
<tr>
<td>ILIDS</td>
<td>Interferometric laser imaging for drop sizing</td>
</tr>
<tr>
<td>I_m</td>
<td>Mixing index</td>
</tr>
<tr>
<td>I/M</td>
<td>Inspection/maintenance (station)</td>
</tr>
<tr>
<td>IMEP</td>
<td>Indicated mean effective pressure (kPa)</td>
</tr>
<tr>
<td>IR</td>
<td>Infrared</td>
</tr>
<tr>
<td>ISHC</td>
<td>Indicated specific hydrocarbon (emissions)</td>
</tr>
<tr>
<td>IVC</td>
<td>Intake valve closing (or closed)</td>
</tr>
<tr>
<td>IVO</td>
<td>Intake valve opening (or open)</td>
</tr>
<tr>
<td>JOBD</td>
<td>Japanese onboard diagnostics (standards)</td>
</tr>
<tr>
<td>L/D</td>
<td>Length-to-diameter (ratio)</td>
</tr>
<tr>
<td>LDPE</td>
<td>Low-density polyethylene</td>
</tr>
<tr>
<td>LDV</td>
<td>Laser Doppler velocity (or velocimetry)</td>
</tr>
<tr>
<td>LEA</td>
<td>Laser extinction and absorption</td>
</tr>
<tr>
<td>LEV</td>
<td>Low emissions vehicle; also LEV II</td>
</tr>
<tr>
<td>LIEF</td>
<td>Laser-induced exciplex fluorescence</td>
</tr>
<tr>
<td>LIF</td>
<td>Laser-induced fluorescence</td>
</tr>
<tr>
<td>LPG</td>
<td>Liquefied petroleum gas</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>MAF</td>
<td>Mass airflow (sensor)</td>
</tr>
<tr>
<td>MAP</td>
<td>(Intake) manifold absolute pressure (kPa)</td>
</tr>
<tr>
<td>MBT</td>
<td>Minimum spark advance for best torque</td>
</tr>
<tr>
<td>MFB</td>
<td>Mass fraction burned</td>
</tr>
<tr>
<td>MFC</td>
<td>Mass flow controller</td>
</tr>
<tr>
<td>MIL</td>
<td>Malfunction indicator light</td>
</tr>
<tr>
<td>MMT</td>
<td>Methylcyclopentadienyl manganese tricarbonyl</td>
</tr>
<tr>
<td>MON</td>
<td>Motor Octane Number</td>
</tr>
<tr>
<td>MPI</td>
<td>Multipoint injection</td>
</tr>
<tr>
<td>MTBE</td>
<td>Methyl-tertiary butyl ether</td>
</tr>
<tr>
<td>NDIR</td>
<td>Nondispersive infrared</td>
</tr>
<tr>
<td>NGV</td>
<td>Natural gas vehicle</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
</tr>
<tr>
<td>NMEP</td>
<td>Net mean effective pressure</td>
</tr>
<tr>
<td>NMHC</td>
<td>Nonmethane hydrocarbon</td>
</tr>
<tr>
<td>NMOG</td>
<td>Nonmethane organic gas</td>
</tr>
<tr>
<td>NOx</td>
<td>Oxides of nitrogen, or nitrogen oxides</td>
</tr>
<tr>
<td>NTC</td>
<td>Negative temperature coefficient</td>
</tr>
<tr>
<td>OBD</td>
<td>Onboard diagnostics; also OBD II</td>
</tr>
<tr>
<td>OBDS</td>
<td>Onboard distillation system</td>
</tr>
<tr>
<td>OFP</td>
<td>Ozone-forming potential</td>
</tr>
<tr>
<td>ORVR</td>
<td>Onboard refueling vapor recovery</td>
</tr>
<tr>
<td>OSC</td>
<td>Oxygen storage material component; also Oxygen catalyst storage content; also Oxygen storage capacity</td>
</tr>
<tr>
<td>OVI</td>
<td>Open-valve injection</td>
</tr>
<tr>
<td>OXSW</td>
<td>Oxidation switch</td>
</tr>
<tr>
<td>PAS</td>
<td>Proportional ambient sampling</td>
</tr>
<tr>
<td>PCM</td>
<td>Programmable control module</td>
</tr>
<tr>
<td>PCV</td>
<td>Positive crankcase ventilation</td>
</tr>
<tr>
<td>PDA</td>
<td>Phase Doppler anemometry</td>
</tr>
<tr>
<td>$p_F$</td>
<td>Partial pressure (of fuel) (kPa)</td>
</tr>
<tr>
<td>PFI</td>
<td>Port fuel injection (or injected)</td>
</tr>
<tr>
<td>PGM</td>
<td>Platinum group metals</td>
</tr>
<tr>
<td>Acronyms</td>
<td>Full Form</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>PIV</td>
<td>Particle image velocity (or velocimetry)</td>
</tr>
<tr>
<td>PLIEF</td>
<td>Planar laser-induced exciplex fluorescence</td>
</tr>
<tr>
<td>PLIF</td>
<td>Planar laser-induced fluorescence</td>
</tr>
<tr>
<td>POM</td>
<td>Acetal copolymer</td>
</tr>
<tr>
<td>POx</td>
<td>Partial oxidation reforming (or reactor)</td>
</tr>
<tr>
<td>ppm C&lt;sub&gt;1&lt;/sub&gt;</td>
<td>HC mole fraction in parts per million (ppm); based on HC as C&lt;sub&gt;1&lt;/sub&gt;H&lt;sub&gt;x&lt;/sub&gt;</td>
</tr>
<tr>
<td>Pt</td>
<td>Platinum</td>
</tr>
<tr>
<td>PWM</td>
<td>Pulse width modulation</td>
</tr>
<tr>
<td>PZEV</td>
<td>Partial zero emissions vehicle</td>
</tr>
<tr>
<td>QWS</td>
<td>Quick warm-up system</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
</tr>
<tr>
<td>RACV</td>
<td>Rotary air control valve</td>
</tr>
<tr>
<td>Reg-Neg</td>
<td>(Reformulated gasoline) Regulation–Negotiation Agreement</td>
</tr>
<tr>
<td>RFG</td>
<td>Reformulated gasoline</td>
</tr>
<tr>
<td>RMS</td>
<td>Root mean square</td>
</tr>
<tr>
<td>RMT</td>
<td>Remote mix tee</td>
</tr>
<tr>
<td>RON</td>
<td>Research Octane Number</td>
</tr>
<tr>
<td>ROV</td>
<td>Rollover valve</td>
</tr>
<tr>
<td>rpm</td>
<td>Revolutions per minute</td>
</tr>
<tr>
<td>RVP</td>
<td>Reid vapor pressure</td>
</tr>
<tr>
<td>SAIR</td>
<td>Secondary air system (monitor)</td>
</tr>
<tr>
<td>SAO</td>
<td>Smooth approach orifice</td>
</tr>
<tr>
<td>S/C</td>
<td>Steam-to-fuel ratio (in reformer)</td>
</tr>
<tr>
<td>SCV</td>
<td>Swirl control valve</td>
</tr>
<tr>
<td>SDIMEP</td>
<td>Standard deviation of indicated mean effective pressure</td>
</tr>
<tr>
<td>SHED</td>
<td>Sealed housing for evaporative determination</td>
</tr>
<tr>
<td>SI</td>
<td>Spark ignition (engine)</td>
</tr>
<tr>
<td>SMD</td>
<td>Sauter mean diameter</td>
</tr>
<tr>
<td>S&lt;sub&gt;p&lt;/sub&gt;</td>
<td>Mean piston speed (m/sec)</td>
</tr>
<tr>
<td>SULEV</td>
<td>Super ultra-low emissions vehicle; also SULEV II</td>
</tr>
<tr>
<td>SUV</td>
<td>Sport utility vehicle</td>
</tr>
</tbody>
</table>
Near-Zero-Emission Gasoline-Powered Vehicles

$T_{10}, T_{50}, T_{90}$ Temperatures at 10, 50, and 90% distillation points, respectively
TAME Tertiary amyl butyl ether
TBA Tertiary-butanol; also t-butanol
TDC Top dead center (of piston travel)
TE Trapping efficiency (of hydrocarbon)
THC Total hydrocarbon
TLEV Transitional low emissions vehicle
TWC Three-way catalyst
TWD Total weighted demerits
$T_{XX}$ Temperature for XX% evaporation of the fuel

$U'$ Turbulence intensity (m/sec)
UEGO Universal exhaust gas oxygen (sensor)
UFC Underfloor catalyst
ULEV Ultra-low emissions vehicle; also ULEV II

VOC Volatile organic compound
VTEC Variable valve timing and lift electronic control
VVA Variable valve actuation
VVT Variable valve timing/control monitor
VVT/L Variable valve timing and lift (system)

WOT Wide open throttle
WRAF Wide-range air/fuel (sensor)
WRO$_2$ Wide-range oxygen (sensor)
WWMP World Wide Mapping Point (Ford)

$X_F$ Fuel mole fraction

$Y$ Hydrogen-to-carbon ratio (of fuel)

ZEV Zero emissions vehicle

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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>δ</td>
<td>Boundary layer thickness (millimeters)</td>
</tr>
<tr>
<td>λ</td>
<td>Fuel/air equivalence ratio</td>
</tr>
<tr>
<td>τ</td>
<td>Characteristic diffusion time (milliseconds)</td>
</tr>
<tr>
<td>Φ</td>
<td>Fuel/air equivalence ratio</td>
</tr>
</tbody>
</table>
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Numbers followed by \textit{f} or \textit{t} denote figures or tables, respectively.

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About the Contributing Authors

Dr. Michael Akard is an Analytical Product Specialist at Horiba Instruments, Inc. in Ann Arbor, Michigan. He earned his B.S. in Chemistry from the University of New Mexico in 1990 and his Ph.D. in Analytical Chemistry from the University of Michigan, Ann Arbor, in 1994. Dr. Akard is the author of 11 articles in journals ranging from *Analytical Chemistry* to the *Journal of Chromatographic Science*. He has made 18 presentations at PITTCON, SAE, and Anachem conferences, and he holds a U.S. patent for a method and a product in high-speed gas chromatography.

Dr. Paul Andersen is Technical Director of Johnson Matthey’s North American Technical Center. He earned his B.S. in Chemical Engineering from the University of Illinois—Urbana and his Ph.D. in Chemical Engineering from Northwestern University. Since joining Johnson Matthey in 1992, Dr. Andersen has worked on the development of various emissions control catalysts, including three-way catalysts, NOx adsorber catalysts, SCR catalysts, and oxidation catalysts.

Professor Choongsik Bae has worked in the Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST) since 1998. He received his B.S and M.S. degrees in Aerospace Engineering from Seoul National University in Korea. He received his Ph.D. in Mechanical Engineering from Imperial College, London, in 1993 and then worked as a Research Associate there. He later joined Chungnam National University and soon moved to KAIST. Professor Bae has been involved in various studies of experimental engine work and research on fuel spray, flow, and combustion in spark ignition and compression ignition engines. In 1997, he received the Arch T. Colwell Merit Award from SAE.

Dr. Todd Ballinger is a Staff Scientist in the Catalytic Systems Division of Johnson Matthey. He graduated from the University of Pittsburgh in 1993 with a Ph.D. in Physical Chemistry/Surface Science. After conducting post-doctoral
research in catalysis and surface science at Texas A&M University and the U.S. Naval Research Laboratory, he joined the Catalytic Systems Division of Johnson Matthey in 1995. There, he has been involved in the development of advanced three-way catalysts and hydrocarbon traps/catalysts for automotive catalytic converters, as well as the development of advanced catalyst systems for achieving very low emissions from vehicles.

Mark Borland is a Senior Engineering Specialist in the Advanced Engine Systems Development Group of DaimlerChrysler Corporation. In his 13 years there, he has worked on the development of emissions systems and control algorithms for both gasoline- and diesel-powered vehicles. Most recently, Mr. Borland was part of the team responsible for the development of software and hardware concepts to meet tailpipe emissions on DaimlerChrysler's first production PZEV vehicle. Mr. Borland earned his B.S. in Mechanical Engineering from the University of Wisconsin—Milwaukee and his M.S. in Applied Statistics from Oakland University in Rochester, Michigan.

Professor Wai K. Cheng is a Professor of Mechanical Engineering at Massachusetts Institute of Technology (MIT) and is the Associate Director of the Sloan Automotive Laboratory at MIT. His research interest lies in engine performance and emissions. Professor Cheng has made major contributions to the mixture preparation process in spark ignition engines, and he has authored more than 70 technical publications. He has received the Ralph R. Teetor Award in 1984, and the Oral Presentation Awards from SAE in 2002 and 2004. He is a Fellow of SAE.

Dr. James A. Eng is a Staff Research Engineer at General Motors Research and Development. He received his Ph.D. from Princeton University, working on hydrocarbon emissions and post-flame oxidation mechanisms from homogeneous charge spark ignition engines. During the past 10 years, Dr. Eng has worked in the areas of chemical kinetics, understanding the effects of fuels on engine performance and emissions, cold-start hydrocarbon emissions, and HCCI combustion.

Timothy Gernant is a Senior Product Development Engineer working on the calibration of onboard diagnostics at Ford Motor Company. He joined Ford in 1995 upon graduation from the University of Michigan, Ann Arbor, with a B.S. in Mechanical Engineering. Mr. Gernant continued his education at the University of Michigan, Ann Arbor, and received an M.S. in Automotive Engineering in 2000. He holds multiple patents relating to OBDII diagnostic systems.
Kathleen Grant has been an OBDII Calibration Engineer at Ford Motor Company for 10 years. She graduated from Wayne State University with a B.S. degree in Electrical Engineering and has worked with diagnostic systems and engine controls for more than 20 years. Ms. Grant has been awarded two U.S. patents relating to OBDII diagnostic systems. Previously, she was a project engineer at General Motors Corporation. Most recently, Ms. Grant has been calibrating OBD functionality on PZEV-emissions-level vehicles.

Christopher Hadre is the Core Design and Release Engineer for vapor canisters with the Evaporative Systems Group of DaimlerChrysler Corporation and has been a specialist in evaporative systems development for more than 5 years. He graduated with a B.A.Sc. in Mechanical Engineering from the University of Windsor in Canada in 1998.

Professor Matthew J. Hall is with the Department of Mechanical Engineering at the University of Texas—Austin, and he has more than 20 years of experience in automotive and vehicle research. He received his B.S. and M.S. in Mechanical Engineering from the University of Wisconsin—Madison and his Ph.D. from Princeton University. Professor Hall was a Post-Doctoral Fellow at the Combustion Research Facility of Sandia National Laboratories and at the University of California—Berkeley. His primary research interests center around combustion processes, with an emphasis on internal combustion engines. Professor Hall’s focus is on experimental measurements studying engine performance, emissions, and flows, with a specialization in optical diagnostic techniques and sensors. He has received several awards from SAE, including the Ralph R. Teetor Award in 1993, the Arch T. Colwell Merit Award in 1985, the Horning Award in 1987, and the Myers Award in 1998.

Dr. David Lafyatis is a Technical Program Manager at Johnson Matthey. He earned his Ph.D. in Chemical Engineering from the University of Delaware and then completed a Post-Doctoral Fellowship at the Rijksuniversiteit Gent in Belgium, studying reaction kinetics in a transient reactor. For the past 9 years, Dr. Lafyatis has worked at Johnson Matthey in the area of exhaust aftertreatment technology.

Professor Ronald D. Matthews obtained his B.S. in Mechanical Engineering from the University of Texas, Austin, followed by three graduate degrees from the University of California—Berkeley, culminating in 1977 with a Ph.D. with a specialization in combustion. He joined the faculty of the Department of Mechanical Engineering at the University of Texas, Austin, in 1980, where he established its combustion and engine research program. Professor Matthews
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is Head of the General Motors Foundation Combustion Sciences and Automotive Research Laboratories on the University of Texas, Austin, campus. In 1980, he founded the SAE student chapter at the University of Texas, Austin, and has served as Faculty Advisor to the chapter since then. For more than 25 years, he has been involved in research in the areas of combustion, engines, emissions, and alternative fuels. Professor Matthews’ research activities also include experimental work and numerical modeling of both fundamental combustion processes and combustion within engines. His present research focuses primarily on controlling hydrocarbon emissions from PFI spark ignition engines, the spark ignition process, engine friction, and alternative diesel fuels. Professor Matthews has received several SAE awards, including the Ralph R. Teetor Award in 1979, the Arch T. Colwell Merit Award in 1992, the Excellence in Engineering Education (Triple E) Award in 2002, the Phil Myers Award in 2002, and the Faculty Advisor Award in 1990, 1997, and 2002. In 1996 and again in 1998, the University of Texas, Austin, body of work on fractal engine modeling was nominated for the ComputerWorld Award and was selected for inclusion in the Smithsonian National Museum of American History, Permanent Research Collection on Information, Technology, and Society. Professor Matthews was elected a Fellow of SAE in 2002.

Kimiyoshi Nishizawa is a Senior Manager of the Powertrain Advanced Engineering Department No. 2 at Nissan Motor Co., Ltd. He graduated from Tokyo University in Japan and received his B.S. in Mechanical Engineering. His first job at Nissan was to design and develop components for gasoline engines. Later, he became an engine systems engineer, focusing on emissions reduction. Mr. Nishizawa’s recent work has focused on developing the PZEV system for the Nissan Sentra CA for the U.S. market, which was launched in February 2000; a ULEV system for the Nissan Bluebird Sylphy for the Japanese market, which was launched in August 2000; and developing emissions systems to meet Japan ULEV standards and applying them to more than 80% of Nissan vehicles sold in Japan in March 2003.

Dr. Stephen Russ is a Technical Leader for Engine Combustion in the V-Engine Engineering Division of Ford Motor Company. He joined Ford after receiving his Ph.D. in Mechanical Engineering from the University of Minnesota, Minneapolis/Twin Cities, in 1993. Dr. Russ worked in the Ford Research Laboratory for six years, conducting research on engine combustion, emissions formation, and advanced diagnostics. For the past five years, he has led the development of several Ford V-engine programs. Dr. Russ has authored 20 SAE technical papers and has organized and chaired SAE technical sessions on engine
combustion and emissions. He also has been awarded 11 U.S. patents for various engine technologies. Dr. Russ was selected to participate in the 1999–2000 SAE Industrial Lectureship Program and has given invited lectures at several universities.

Professor Tariq Shamim is an Associate Professor of Mechanical Engineering at the University of Michigan—Dearborn. He is a graduate of the University of Michigan—Ann Arbor, where he received both his Ph.D. in Mechanical Engineering and his M.S. in Aerospace Engineering. Professor Shamim received another M.S. in Mechanical Engineering from the University of Windsor in Canada and a B.S. in Mechanical Engineering from the NED University of Engineering and Technology in Karachi, Pakistan. His research and teaching interests are in the area of computational thermo-fluids, with major emphasis on combustion, emissions control, fuel cells, and thermal spray. Professor Shamim’s research is supported by the National Science Foundation, U.S. Department of Energy, U.S. Department of Defense, and the automotive industry. He is actively involved with several professional organizations, including SAE, American Society of Mechanical Engineers (ASME), and the Combustion Institute. In 2004, he received the Ralph R. Teetor Award from SAE.

Jenny Spravsow has been employed by DaimlerChrysler since 1998 and currently holds the position of Product Development Engineer in the Advanced Evaporative Systems Group. She earned her B.S. in Mechanical Engineering from Lawrence Technological University in Southfield, Michigan, and her M.S. in Mechanical Engineering from Oakland University in Rochester, Michigan.

Glenn Zimlich is an OBD Calibration Technical Expert at Ford Motor Company. He joined Ford in 1990, after completing his Bachelor of Mechanical Engineering at the University of Detroit. He completed his Master of Mechanical Engineering from the University of Detroit in 1993. Mr. Zimlich has received multiple U.S. patents relating to onboard diagnostics.
About the Editor

Dr. Fuquan (Frank) Zhao currently is the Vice President of Product Engineering, and General Manager for the R&D Center at Brilliance Jinbei Automobile Corporation in Shenyang, China. In this position, Dr. Zhao is responsible for all activities related to vehicle product development.

Prior to this position, he was a Research Executive of Technical Affairs at Daimler-Chrysler Corporation. In this position, he was responsible for providing technical guidance and advice to all product team managers and engineers within DaimlerChrysler Corporation relating to engine development issues and advanced powertrain technologies. He represented the Chrysler Group in various consortium activities and served as a technical spokesman.

Dr. Zhao’s other experience includes time as an Assistant Professor in Mechanical Engineering at Wayne State University, a Research Fellow at the Imperial College of Science, Technology, and Medicine in the United Kingdom, and a Postdoctoral Fellow at Wayne State University and the University of Hiroshima. Dr. Zhao received his B.S. in Mechanical Engineering from Jilin University of Technology (China) in 1985. He obtained his M.S. in Mechanical Engineering from the University of Hiroshima (Japan) in 1989 and his Ph.D. there in 1992.

Dr. Zhao is the principal author of more than 100 technical research papers on various subjects. He is the principal author of the book, Automotive Gasoline Direct-Injection Engines, published by SAE in 2002, and he is the leading editor of the book, Homogeneous Charge Compression Ignition (HCCI) Engines, published by SAE in 2003. Dr. Zhao also is the leading editor of the books...
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Direct Fuel Injection for Gasoline Engines and Advanced Development in Ultra-Clean Gasoline-Powered Vehicles published by SAE in 2000 and 2004, respectively. He has received several prestigious awards to recognize his technical achievements and his leadership in professional societies, including the 2002 SAE Forest R. McFarland Award. He served as the chair of the Combustion Committee for the SAE Fuels and Lubricants activity from 2002 to 2004. He is a Fellow of SAE. Currently, Dr. Zhao holds an honorary professorship from several leading Chinese Universities.