The new allure of electric cars: Blazing-fast speeds

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Already noted for saving gasoline and having zero emissions, electric cars have quietly taken on an unlikely new dimension — the ability to reach blazing speeds that rival the 0-to-60 performance of a typical Porsche or BMW, and compete on some racecourses with the world's best gasoline-powered cars, an authority said here today at a major scientific conference.

Speaking at the 246th National Meeting & Exposition of the American Chemical Society (ACS), electric vehicle pioneer John E. Waters said that relatively recent advances in engineering and use of lithium-ion batteries are producing electric vehicles (EVs) capable of leaving traditional internal combustion engine race cars in the dust.

"Experimental electric cars already have achieved sustained speeds of more than 180 miles per hour, and established world speed records above 300 mph," Waters said. "Electric cars have inherent advantages in efficiency and torque over gasoline-powered vehicles. Energy storage-to-torque on an EV platform is above 90 percent efficient, compared to less than 35 percent for internal combustion engines. I have no doubt that battery-powered race cars will be attracting race fans in the immediate future."

His talk was among almost 7,000 presentations on new advances in science and other topics scheduled for the meeting, which continues through Thursday in the Indiana Convention Center and downtown hotels. It was among many talks that connect with the meeting's theme, "Chemistry in Motion," selected for the venue — which is the location of the Indianapolis 500 and the Indiana Motor Speedway.

Waters pointed out that race cars and racetracks do more than thrill an estimated 90 million motorsport fans in the United States alone. In addition, they have served historically as testbeds for new automotive technology, the place where top-notch performance fosters wider public acceptance of the technology to be found eventually in consumer cars. That is proving true as EVs attain breathtaking speeds, puncturing myths about (slow) EV performance. In the early 1990s, Waters helped develop the battery pack system for General Motors' electric car, the EV1; helped set an EV world speed record at 183 mph; later founded Bright Automotive, a company that invented a 100-mpg plug-in hybrid electric commercial vehicle; and now heads Waters and Associates, LLC, a consulting firm specializing in global sustainable mobility and housing.

Electric race cars have such a great capacity for speed because they utilize energy more efficiently than internal combustion engines, Waters explained. Turning gasoline into motion involves multiple steps that transfer motion from pistons to a crank shaft, to a flywheel, through a transmission and other mechanisms to finally reach the wheels. Each step consumes energy before it can become applied as motion, or torque, to the wheels. In an EV, in contrast, the conversion is more direct, from batteries to an electric motor that operates with negligible friction (electic motor still goes through a simplified gearbox and other mechanisms to the wheels). EV motors often provide up to 15,000 revolutions per minute (rpm), compared to less than 8,000 rpm for internal combustion engines (consumer cars usually provide less than 6,000). The high rpm of the electric motor eliminates the need for heavy and expensive transmissions.

The bottom line, Waters said, is that EVs have "instant torque," the twisting motion that turns wheels, that has enabled test cars to zip from 0 to 60 mph in less than 4 seconds. Waters said, "It's hard to believe unless you experience it. Every Tesla owner knows what I am talking about."

A limiting factor for electric race cars on oval courses is sustaining speeds over 150 mph. Due to the tremendous energy consumed to overcome aerodynamic drag at those speeds, current lithium batteries could only last about 10 minutes before a pit stop, Waters pointed out.

"Racing in excess of 150 mph on high-speed ovals will take a significant breakthrough in battery technology for EV race cars, or racetracks, to be competitive in the Indianapolis 500 or NASCAR events," Waters said. Interestingly, there has been some discussion about modifying oval racetracks so that EV race cars could actually charge their batteries while racing. "It brings full-scale images of slot car racing — everyone's first racing experience as a kid!" Waters said.

Road-course racing, which takes place on real streets with turns and a lot of braking, however, is another matter. Technology such as regenerative braking, which recovers energy to recharge the battery, means the EVs can race from 0 to 150 mph for about 35 minutes, which is a comparable racing time to internal combustion engine racing.

"On road courses today, EVs already can compete with the fastest cars in the world," Waters said. "With the dawn of new and advanced energy storage, we will soon see supercars — electric race cars with instant torque — that accelerate in a blink of an eye and reach top speeds of 200 mph or more. And this will all happen with an appealing but moderate sound, minimal heat and absolutely no exhaust fumes belching from exhaust pipes. And one more thing: It will cost race teams less money to own and operate their cars than they spend today on non-sustainable technology."

More information: Abstract

Chemical reactions providing forward motion. Forward motion at record-breaking speeds. Historically, the thoughts of chemicals and racing conjure paradigms of combustion, explosions, pistons, emissions, crankshafts, rotational forces, drive shafts, smoking tires, and noise, noise, noise. Ever since the "horseless carriage" was invented, drivers have raced their machines against one another, pushing the realms of technological advancement in chemistry, materials, precision, torque, horsepower, electronics, aerodynamics and friction.

With the dawn of new and advanced energy storage, supercar performance is being provided by efficient electrochemical reactions channeling electron directly into electric drives with instant torque characteristics. This high performance efficiency can be measured at three to four times over internal combustion engine drivetrains and yields minimal heat, minimal noise, and no emissions.

Lithium ion chemistry is known as the "rocking chair" battery as ions rock back and forth from one electrode (cathode) to the other (anode) during charge and discharge cycles. The ions become embedded in a porous electrode material through a process known as intercalation. During normal charge-discharge cycles, the lithium ion can repeatedly travel at greater than 95 percent efficiency and can perform this feat 10 to 30 times more than any other battery ever mass-produced.

There are a variety of chemistry combinations within the Lithium family. From Lithium Cobalt Oxide (LCO) to Lithium Ion Phosphate (LFP) to Lithium Titanate Oxide (LTO), the battery engineer can now tailor designs to maximize performance outputs for high power or high energy. Some lithium battery concepts are now capable of powering speeds in excess of 300 MPH.

A new era of electrochemistry has brought a new paradigm for racing enthusiasts to discover and embrace. Motorsport has always been about pushing the realms of technological advancement, and advanced chemistry is ushering in a new era for all race fans to enjoy.

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