Press Release

Next-Generation Steel to Make More Fuel-Efficient Cars and Reduce Carbon Emissions

Researchers at Masdar Institute Create Computational Tool to Design Strong, Light and Flexible Steel for Cars

Abu Dhabi-UAE: 04 May, 2015 – Researchers at the Masdar Institute of Science and Technology are designing a new kind of steel, known as next generation steel, to improve the fuel efficiency of cars and reduce the carbon emissions they produce.

Dr. Rashid Abu Al-Rub, Associate Professor of Mechanical Engineering at Masdar Institute, is one of nine scientists commissioned by the US Department of Energy to lead the design of the next generation of advanced high strength steel that meets the light-weight, strength, flexibility, and safety requirements of the auto industry and is equivalent in price to traditional steel.

Dr. Abu Al-Rub and his graduate student Najmul Hasan Abid have developed a computational tool that can virtually design the microstructure of steel – which is what makes steel strong and flexible. By designing and examining steel at this microstructural level, they were able to predict the overall strength and formability of the proposed steel.

“This simulation tool is a highly efficient alternative to the way high-strength steels are currently being produced and tested. The tool will make it quick, easy and affordable for car manufacturers and scientists to create and test their desired steel,” Dr. Abu Al-Rub said.

Steel is the material of choice for automobiles; it is very strong as well as malleable, and its cost is relatively low compared to many other metals. But steel is heavy; over two-thirds of a car’s weight comes from steel, which has a substantial impact on the car’s fuel efficiency, which in turn has a big impact on the amount of carbon emissions released into the atmosphere. In the US alone, about 1.7 billion tons of greenhouse gases are released into the atmosphere each year from highway vehicles, accounting for nearly 32% of annual carbon dioxide emissions. Here in the UAE, carbon emissions are considered a challenge to the country’s air quality and overall sustainability, and the government has targeted their reduction in the Abu Dhabi Environment Policy Agenda.

Reducing a car’s weight by 10% can improve fuel efficiency by 6% to 8%, and since steel is the heaviest part of the car, it has a big role to play in making the car lighter.

After designing the microstructure of the steel, Dr. Abu Al-Rub and Abid ran several “what-if” scenarios to assess the steel’s flexibility and durability in different situations and environments. After many design trials, they found that adding nanoparticles significantly enhances the steel’s

flexibility without compromising the strength. By adding a small fraction of nanoparticles, the steel's flexibility increased 40-50%.

"Rather than repeatedly building and testing the steel in a lab until coming up with the best steel – a process that takes many trial and errors, high manufacturing costs, and several months to complete – our design tool will allow users to tweak the steel's microstructure and combine various amounts of nanoparticles and other phases in order to achieve specific levels of strength and flexibility before manufacturing the steel. Once the design and combinations are finalized, then the manufacturing of the steel can commence," Dr. Abu Al-Rub added.

The novel steel has many other potential applications outside of the auto industry; the aerospace and construction industries as well as the oil and gas industry could greatly benefit from such a flexible and, light-weight metal.

"Our next step is to engage the UAE's steel industry and share with them the type of steels we have discovered. We hope that the innovative, high-grade and light-weight steel we are now validating will serve to advance and further diversify the UAE's economy and contribute to the transport sector, which is one of the seven sectors targeted in the new UAE Innovation Strategy," Dr. Abu Al-Rab added.

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About Masdar Institute

The Masdar Institute of Science and Technology (Masdar Institute) was established by the government of Abu Dhabi as a not-for-profit, private graduate university to develop indigenous R&D capacity in Abu Dhabi addressing issues of importance to the region.

In collaboration with the Massachusetts Institute of Technology (MIT), Masdar Institute has developed an academic and research platform that articulates its mission and vision according to critical energy and sustainability challenges. An important characteristic of Masdar Institute is its focus on complex real-world problems that require a multidisciplinary approach for the development of solutions from an integrated technology, systems and policy perspective. This multi-interdisciplinary and integrated approach is supported by the structure of its academic programs and by the emphasis placed on engaging external partners from industry, government, and other academic institutions in collaborative activities.

Serving as a key pillar of innovation and human capital, Masdar Institute remains fundamental to Masdar's core objectives of developing Abu Dhabi's knowledge economy and finding solutions to humanity's toughest challenges such as climate change.

Masdar Institute integrates theory and practice to incubate a culture of innovation and entrepreneurship, working to develop the critical thinkers and leaders of tomorrow. With its world-class faculty and top-tier students, the Institute is committed to finding solutions to the challenges of clean energy and climate change through education and research.

Masdar Institute offers degrees in:

- MSc Engineering Systems and Management
- MSc Computing and Information Science
- MSc Materials Science and Engineering
- MSc Mechanical Engineering
- MSc Water and Environmental Engineering
- MSc Microsystems Engineering
- MSc Electrical Power Engineering

- MSc Chemical Engineering
- MSc Sustainable Critical Infrastructure
- PhD in Interdisciplinary Engineering

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