High-strength material advancements may lead to new, life-saving steel

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There has been great advancements in the development of the high-strength steel and the need for additional enhancements continue to grow. Various industries have a need for structural components that are lighter and stronger, improve energy efficiencies, reduce emissions and pollution increase safety and cost less to produce, particularly in the automotive industry.

A group of researchers in Wayne State University's College of Engineering have been working to create advanced materials with high-yield strength, fracture toughness and ductility. Their efforts have led to the development of a new material consisting of bainitic steels and austempered ductile iron that has all these characteristics, ultimately resisting fatigue that can cause fractures in materials often with catastrophic consequences.

The group, led by Susil Putatunda, Ph.D., professor of chemical engineering and materials science in WSU's College of Engineering, has focused on developing novel materials using unique processing technique. These materials are processed from existing raw materials used in the steel industry and can be heat treated using currently available industrial austempering process. According to Putatunda, this third generation advanced high strength steel has a number of advantages over the currently available steels currently being used in industry today.

"Our steel has twice the yield strength, has a very high tensile strength, and is close to three times the fracture toughness over advanced steels

currently on the market," said Putatunda. "In addition, it has improved strength for fatigue and impact, improved durability, lower weight, and the austempering process reduces energy consumption and eliminates the post-treatment process."

The new steel being developed by Putatunda's research group is a high bainitic steel with an extremely fine scale microstructure consisting of ferrite and carbon stabilized austenite. It has high carbon and high silicon content, and after the austempering process - an isothermal heat treatment - produced a structure that is stronger and tougher than other types of steel. The austempering process is a more energy efficient heat treatment process that does not require post-heat treatment, therefore leading to additional energy savings.

Putatunda continues to do research on his high-strength steel through the support of the National Science Foundation, the Michigan Initiative for Innovation & Entrepreneurship, and Applied Process, Inc. Independent ballistic tests done in Canada have been conducted and have shown excellent results. As a consequence, the steel may be useful in improvised ballistic explosive attacks.

"The steel has been found to have the strength and durability necessary for armored vehicles to resist improvised explosive devices because of its extremely high fracture toughness," said Putatunda. "Our steel could potentially save human lives against explosive attacks."

This technology is ideally suited for cast steel parts and is currently in the manufacturing validation development stage at a steel casting plant.

More information: To learn more about Putatunda's research, visit www.eng.wayne.edu/page.php?id=511

Provided by Wayne State University