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Novel nanostructured high strength steels for automotive lightweight applications

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Abstract

Climate change, in particular, global warming has become a severe issue worldwide over the last decades. CO_2 is the most important greenhouse gases and its emissions have played a predominant role in climate change. To ease climate change and ensure the sustainable development of human beings, enormous mitigation measures have been implemented to reduce CO_2 emission in different sectors. To limit CO_2 emissions in transport sectors, the improvement of fuel efficiency drives the lightweight concepts in the automotive industry. To reduce the weight of vehicles is believed to be an effective way to enhance fuel efficiency. It was reported that a reduction in automotive weight by 10% can results in an improvement in fuel economy by 6% - 8%.

The challenge of climate change stimulates materials scientists and engineers to develop new materials with high or ultrahigh strength as well as reasonable formability. Advanced high-strength steels are of prime interest for sheet metal forming for automotive lightweight applications. In particular, medium- and high-manganese steels use manganese to stabilize the austenitic phase. Apart from dislocation slip, various deformation modes, such as transformation-induced plasticity (TRIP), twinning-induced plasticity (TWIP), and microband-induced plasticity (MBIP), can be activated in this new group of advanced high-strength steels. The new alloying concepts and complex annealing cycles promote the development of nanostructures in steels, such as nano twins, deformation-induced martensite, ultrafine-grained microstructure, nano-sized intermetallic phases, short-range ordering, etc. A complex interplay of nanostructures results in an extraordinary strain-hardening capacity and combination of high strength and superior ductility. In the present talk, the development and characteristics of next-generation advanced high-strength steel will be introduced. In addition, this talk will provide case studies of novel steel and process design with a focus on automotive lightweight applications.

Biography

Dr.-Ing. Wenwen SONG received her Ph.D. with summa cum laude in 2014 from rwth aachen university, Germany. from 2014 to 2016, she worked as postdoctoral researcher in the steel institute of rwth aachen university. During september 2015 to march 2016, she stayed at the university of cambridge as a guest researcher. in 2016, dr.-ing. song built up her own research group “nano structured materials” at steel institute of rwth aachen university, focusing on developing new concepts of alloy and microstructure design for enhanced material performance by applying a combined experimental and simulation tools. in 2018, she stayed at the university of oxford as a “theodore von kármán-fellowship” holder.

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