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## IMPROVED BALANCE OF CONFLICTING MECHANICAL PROPERTIES IN ADVANCED HIGH STRENGTH STEELS

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**Key words:** Advanced high strength steels, microstructure, formability, alloying, processing

### **Abstract**

Optimizing the balance of conflictive mechanical properties like strength, toughness, fatigue, formability is the key issue of current steel and process development. Therefore, new steel design concepts use high Mn contents for controlling low temperature phase transformations, for stabilizing the fcc phase, and for adjusting the stacking fault energy. By this, extremely fine microstructures down to the nm-level can be achieved. Heterogeneous microstructure combines various phases, including metastable phases, enable new combinations of mechanical properties, especially when phenomena such as the TRIP, TWIP, or MBIP effects are triggered. Materials that have one or more of these special features are summarized under the term Advanced High Strength Steels (AHSS).

The talk will report on recent results for various AHSS. This will be done in the order of increasing manganese content as the characteristic alloying element for AHSS. For complex phase steels, the challenging description of the heterogeneous microstructure will be discussed and the competition of dual phase and complex phase steel with respect to global and local formability will be elucidated. For dual phase steels, particular attention is paid to the role that microstructural details play in cold formability and in the formation of cracks. The effectiveness of alloying elements and modified process paths for improved mechanical properties is worked out. For medium manganese forging steels, the control of low temperature phase transformations is required for improved toughness and fatigue behaviour. With higher Mn contents in medium Mn steels metastable phases become interesting; this applies equally to the microstructure setting and to the mechanical properties. The interaction of alloying elements can no longer be neglected; special challenges in process technology now also must be considered. This will be highlighted, as an example, for continuous casting and for continuous annealing.

The talk will look at developments in the recent past and show possible areas of application for the newly developed steels. Conclusions about the importance of new design principles are drawn.