Microalloying to Develop Third Generation Advanced High Strength Steels

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There is currently a push to develop new grades of steels and processing routes that can provide materials with high mechanical strength while maintaining formability. This goal can be achieved by increasing the manganese content to stabilize austenite to room temperature to form second generation advanced high strength steels (2GAHSS). These steels, however, are expensive due to high alloying additions, are difficult to produce, and are prone to delayed cracking. Moreover, such grades of AHSS are hard to apply to currently available steel manufacturing processes. In order to design third generation advanced high strength steels (3GAHSS) for automotive applications, an alloying approach to stabilize some austenite in a martensitic or bainitic microstructure is key. Further mechanical property improvement can be achieved via prior austenite grain size conditioning through microalloying. A newly installed lab-scale vacuum induction melt furnace was used to cast steels with the addition of microalloying elements under a controlled environment. The goal was to provide inclusion-free, accurately alloyed developmental 3GAHSS chemistries to measure mechanical properties and optimize processing routes of selected 3GAHSS chemistries. Various alloying elements from carbon to chromium were used in this study, and the associated laboratory processes including homogenization and subsequent thermo-mechanical processes are discussed.