Flash® Processed Steel for Automotive Applications

DE-SC011857

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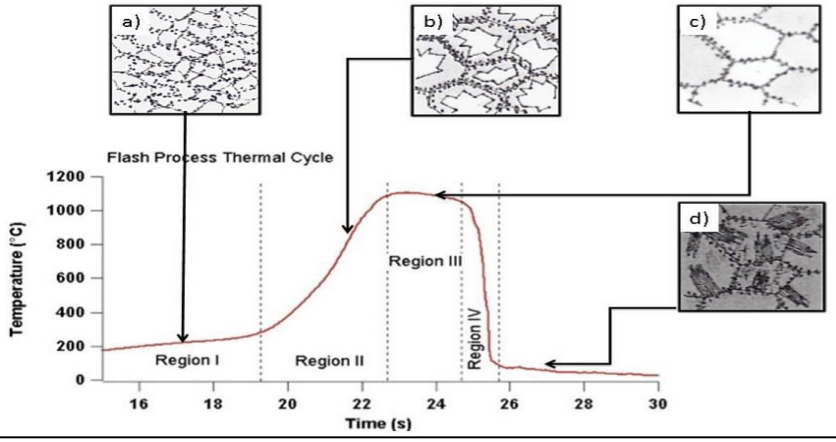
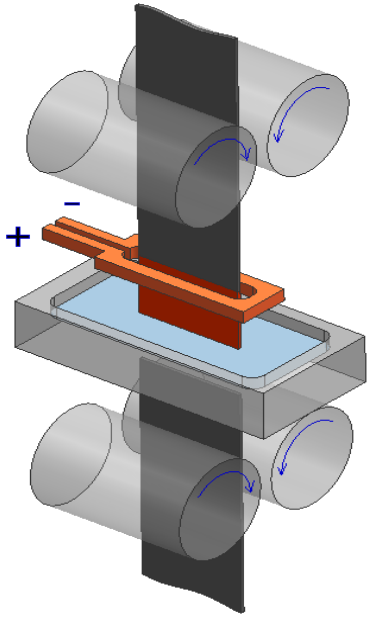
Project Objective

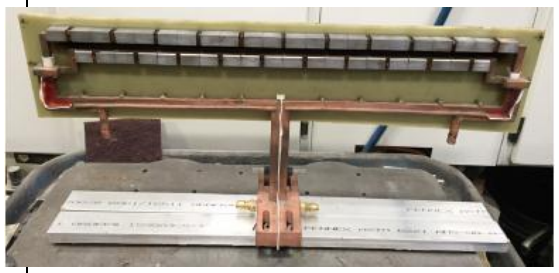
- Create a process for making Advanced High Strength Steel (AHSS) that
  - Uses plain carbon (AISI 1020) steel as a feedstock
  - Has a tensile strength of 1500 MPa or higher
  - Has the necessary formability to be cold stampable
  - Is readily weldable
  - Represents a > 30% weight savings to OEMs compared to other AHSS like DP1000.
  - Represents a > 40% per part material cost savings to OEMs compared to cold-forming DP1000.
  - Represents a > 50% per part cost savings to OEMs compared to hot-stamping 1500MPa steel.
- This task is difficult because after decades of research by 10,000 metallurgists around the world, no steel technology previously existed to produce steel that meets this criteria.

Technical Approach





a) In Region I, the steel is preheated to about 200 °C due to thermal convection in the steel.
b) In Region II, the rapid increase to a temperature of over 1000 °C promotes the formation of austenite, which increases the ability of the material to absorb carbon in the crystal structure.
c) In Region III, austenite forms with multiple carbon concentrations present in grain sizes from 5 to 7 microns.
d) In Region IV, the rapid, controlled cooling rate limits carbon diffusion from the crystal structure and leads to the formation of a complex heterogeneous mixture of low carbon ductile bainite and high carbon strong martensite.



Flash Processing leverages the inherent heterogeneity in steel to develop an engineered micro segregation of phase and chemistry by limiting carbon migration and carbide dissolution. Multiple organizations have analyzed Flash.

- Two Masters theses from The Ohio State University, guided by Dr Suresh Babu (now at Oak Ridge National Lab/Univ of Tennessee – Knoxville) fully rationalized the transformation mechanism of Flash Bainite. Weldability was studied in conjunction with Edison Welding Institute.
- US Army ARDEC, Aberdeen Test Center, and Army Research Labs predicted a simultaneous cost and weight savings with simultaneous enhanced performance.

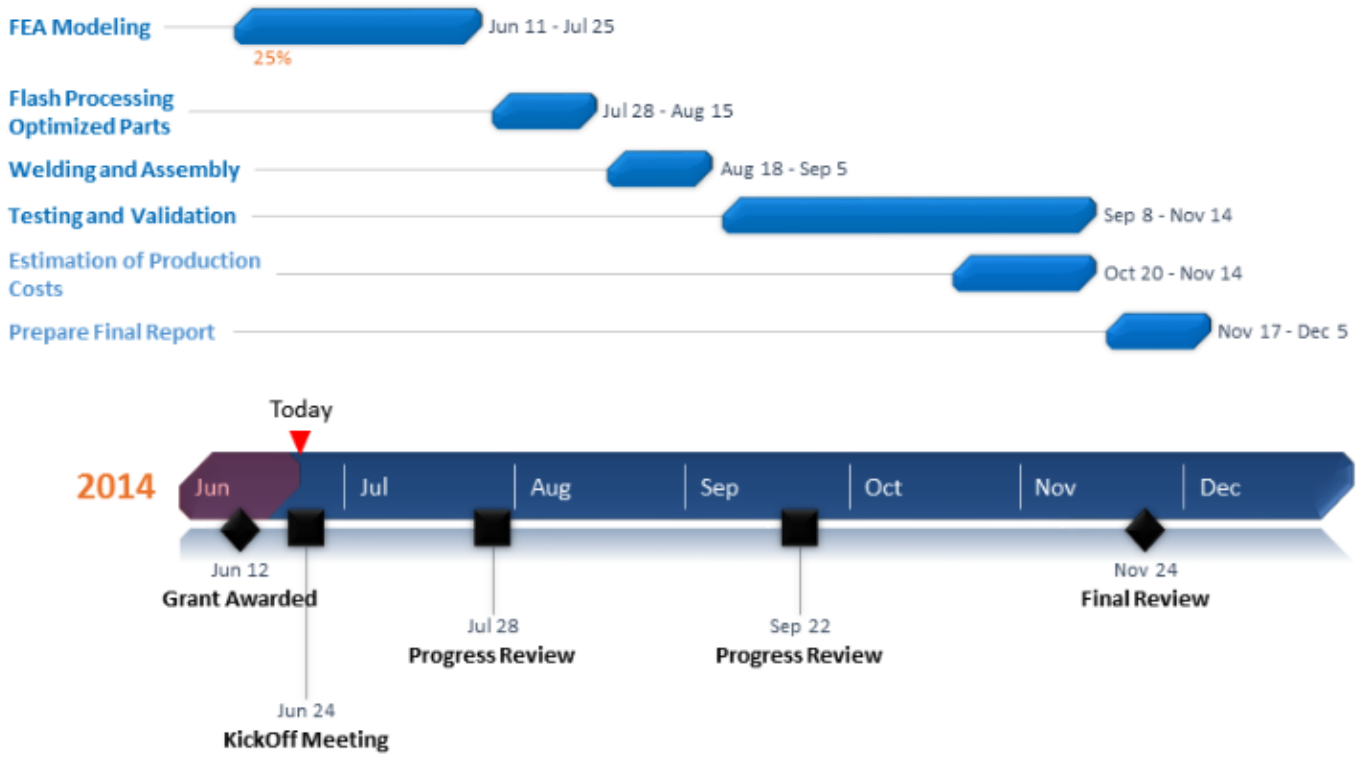
Transition and Deployment

- The end goal is to use Flash Process AHSS to make cars that are safer, lighter, and more fuel efficient.
- The end user of Flash Processing technology is the Auto OEM. In daily driving, the vehicle's owner will benefit from reduced fuel consumption.
- Commercialization will occur via Pilot Line development ultimately resulting in OEM/Tier 1 adoption/licensing of the technology at the manufacturing center itself.

Measure of Success

- The Projects success resulted in cold stamped sheet metal components such as B-pillars, roof rails, floor reinforcements, and seating components being made 33% lighter, readily weldable, and with 40% less material cost. Flash technology, once commercialized will allow tens of pounds of weight savings with $10s of cost savings to Auto OEMs *per vehicle*.
- The lifetime embodied energy savings for a given model year of 16 million cars sold in the US using Flash Processed steel would exceed 1.04 Quad. As Flash steel penetrates multiple model years, this translates to a savings of 9B gallons of gasoline worth $27B annually to consumers.

Project Management & Budget



- The 9 month, $150K Phase I SBIR was completed ahead of schedule in 6 months.
- The stated goal of building an F150 trailer hitch receiver was accomplished in 3 months. Further work ensued developing stamped Automotive components.

Results and Accomplishments

- The Flash Bainite for Automotive Applications Phase I SBIR is complete. Flash Bainite sheet metal has been scaled up from 3" wide to now 24" wide and relevant automotive components cold stamped at 1500MPa.
  - A new method of Induction heating was developed hybridizing transverse and longitudinal flux magnetic field practices. Four different induction coils successfully Flash Processed sheet metal up to 24" wide.
  - B-pillars, floor reinforcements, roof rails and seating components have been cold stamped at 1500MPa offering a 33% mass reduction and 40% cost savings.
  - Multiple Auto OEMs have been so impressed with the results that relevant parts have been made of Flash 1500 for each. ***OEMs want to know "when" Flash will be fully commercialized and available for their use in vehicles.***