A road map to process ferritic martensitic steels using additive manufacturing

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Additive manufacturing (AM) is a disruptive manufacturing process which has found widespread adoption in the automotive, aerospace and fossil fired power industries. However, the nuclear industry has been slower to capitalize on the seeming benefits of AM despite significant data available from the analogous welding techniques already in use. One challenge is the current lack of qualification pathways for AM in the nuclear industry. To address this gap, ORNL researchers are actively working to demonstrate and qualify AM techniques to fabricate ferritic martensitic steels. This paper focuses on the process-structure-property correlations of ferritic martensitic steels (HT9 and Grade 91 in particular) fabricated using additive manufacturing. Ongoing activities pertaining to chemistry refinement, process design and control, post processing heat treatments and the corresponding effects on the microstructure will be explored. While the mechanical properties of both these steels are on par with their wrought counterparts, the microstructure characterization shows significant fraction of phases which could deteriorate the mechanical properties in the as-printed state. Therefore, in addition to the post processing treatments, synergies with welding will be explored and a pathway to develop new additive grades of ferritic martensitic steels will be discussed.