Abstract

Challenges Facing Additive Manufacturing Applied to High Temperature Nuclear Components

There is increasing interest in using additive manufacturing for structural materials in nuclear energy. This requires that the manufacturing methods be qualified in codes and standards, such as the ASME Boiler and Pressure Vessel Code. Additive manufacturing material properties are a result of feedstock material as well as processing methods/parameters, which makes quality control difficult. For low-temperature qualification, this has been circumvented by requiring witness specimens that meet specified property requirements. However, qualification will become significantly more challenging when time-dependent properties must be considered. High temperature qualification requires design models based on creep as well as creep-fatigue interaction, which are significantly affected by microstructure. Testing for these is time intensive and costly. Additional witness specimens to cover time-dependent properties would significantly increase the cost and delay processes, so novel qualification methods are needed for high temperature applications.