High-Efficiency Electrochemical Test Facility for Corrosion and Hydrodynamic Analysis in Molten Salts

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ABSTRACT:

Key to the successful development of economically competitive molten salt reactors is understanding and minimizing corrosion. The state-of-the-art approaches to measuring and characterizing corrosion of materials in molten salt have been immersion of coupons in molten salts (static testing) and flow loops. The method of immersing coupons has the advantage of being simple and low-cost, but do not replicate the hydrodynamic conditions of an MSR. Flow loops excel at replicating the hydrodynamics but are more expensive and require large amounts of molten salt. An intermediate solution where a small-quantity of molten salt could be used to measure corrosion behavior under hydrodynamic conditions similar to an MSR would be able to accelerate development of MSR and assist in optimizing test conditions and materials in flow loops, hot cells and post-irradiation examination facilities. The rotating cylindrical electrode (RCE) provides this intermediate test capability and would provide low-cost, high throughput testing in which the hydrodynamic conditions of a MSR are simulated. The RCE can produce well-characterized flow that can simulate the targeted operating conditions in an MSR by using dimensionless analysis. Furthermore, the RCE can provide real-time feedback on corrosion rates via current measurements. The High-Efficiency Electrochemical Test (HEET) facility would utilize two RCE in separate high-temperature electrochemical cells to perform in situ, real time hydrodynamic property and material corrosion measurements in molten salts.