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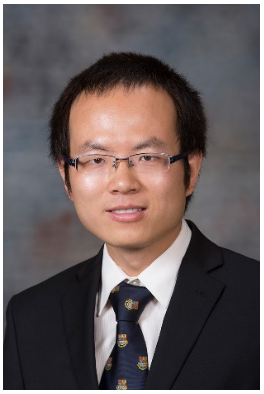

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Diamond-Coated Metallic Structures for Molten-Salt Thermal-Energy Storage Systems

Abstract.
The research goal is to develop a low-cost, large-area deposition method for diamond coatings on metallic structures to address critical corrosion issues in molten-salt thermal-energy storage (MSTES) systems for solar thermal and nuclear power stations. Due to their high boiling points and heat capacities, as well as low viscosity and vapor pressure, molten salts have become the most promising thermal storage medium. Materials for the metallic structures in MSTES systems are made of carbon steels, stainless steels, and/or nickel-based alloys, depending on the operating temperatures. However, these structural materials exhibit high corrosivity in harsh high-temperature, molten-salt environments.

This proposal is driven by a scientific hypothesis that diamond coatings have high corrosion resistance to molten salts and high thermal conductivity for the heat transfer needed. The key innovations include: 1) diamond coatings providing a high molten-salt corrosion resistance, wear resistance, and thermal conductivity; 2) fast deposition of diamond coatings on stainless steels and nickel-based alloys in open air using an original laser-assisted chemical vapor deposition (LCVD) developed in the PIs' labs; and 3) interface engineering to improve the adherence of diamond coatings on the metallic substrates. Protective diamond coatings can extend the lifetime and reliability of metallic structures of the MSTES systems and thus reduce the maintenance and replacement costs. This proposal will address the DOE Energy Storage Grand Challenge by sustaining the global leadership of the US in thermal energy storage utilization and exports with a secure domestic manufacturing supply chain. This NCESR project will provide the resources needed to develop the key data and process design to extend the landscape of the utility industry and create a research platform for future DOE funding.