1. **Research Title:** Physics-Based Modeling of Agile Composite Manufacturing
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

M.S. or Ph.D. student in Mechanical, Chemical, or Composites Engineering Discipline

4. **Objectives:**
    a. Develop a flow model(s) for infusion of low melt viscosity, high temperature polymer resins.
    b. Characterize void formation, transport, and interactions across length and time scales.
    c. Validate infusion flow model(s) using experimental collaboration (e.g. actual resin injection experiments in a flat panel mold or a more complex part geometry).
5. **Description:** Conventional manufacturing of aerospace composites, such as autoclave processes, result in high quality parts but are costly and time intensive. Many alternatives, such as resin transfer molding (RTM) or additive manufacturing (AM), are more agile and cost effective; however, it is nontrivial to achieve quality parts free from defects. Often processes which mitigate defects are discovered through trial and error and are specific to certain part geometries, polymer resins, or composite fibers. In this project, we aim to develop a more physics-based understanding of agile and cost effective manufacturing of aerospace composites through a combination of computational modeling--across various length and time scales--and complimentary experiments. To this end, mathematical and computational models will be developed towards: 1) unveiling mechanisms for void formation in polymer resins, 2) modeling void transport, interaction and coalescence, 3) modeling the wetting and bonding of resin to fibers within tows. This project is expected to lead to physics-informed design of robust and high quality RTM and AM manufacturing processes for high temperature and multifunctional aerospace composites.
6. **Research Classification/Restrictions:** US Citizens only. The resins that will be used in the program are considered at the least, commercecontrolled.
7. **Eligible Research Institutions:** Any
8. **PA Approval #:** AFRL-2025-4282