

Attachment 1 – DAGSI Research Topic Template

NOTE: Under the Cooperative Agreement, Technical Directorates have three options for topics. First, a topic can strictly be considered in the pool for the state allocation of funding. DAGSI will work across the TDs for this allocation. Second, the TD can be prepared to be a funding partner with the State of Ohio. This would include: providing additional funds to support additional recipients of a topic, or expand the proposers team to include additional members on a topic. Third, the TD may elect to fully fund a topic not selected for State of Ohio funding or to pursue University teams outside the State of Ohio. Contact lindsay.kotouch.2@us.af.mil for questions.

1. **Research Title:** Self-driving lab for nanomaterials processing

2. **Individual Sponsor:**

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

Chemistry, Materials Science (BA/BS, MS or PhD level)

4. **Objectives:**

- Develop a fluidic system for the synthesis and surface functionalization of metal nanoparticles
- Optimize nanoparticle size and yield using in-line characterization tools and machine learning
- Functionalize the nanoparticles in flow to enable sensing with high specificity
- Print nanoparticles onto paper-based substrates and evaluate their sensor performance using surface-enhanced Raman spectroscopy
- Establish twin setups for cross-validation

Description: The rise of self-driving labs (SDLs) has heralded an unprecedented age in boosting R&D efforts towards real-world applications and commercialization. In this context, the use of complex artificial intelligence and machine learning (AI/ML) tools can not only speed up research but also improve reproducibility, and by traversing multi-dimensional parameter spaces, enable new research discoveries. At AFRL, we are developing an SDL for the automated synthesis of metal nanoparticles, followed by printing of nanoparticle-based devices as field-deployable, surface-enhanced Raman spectroscopy-based chemical sensors. This project involves automated high-throughput nanoparticle (e.g. Au nanostars) synthesis in flow chemical reactors enabled by ML optimization. Additionally, we are

also interested in automated processing and printing methodologies on paper-based substrates for developing the sensors [1,2]. Finally, experience with ML-based spectral classification and signal deconvolution is desired. This work brings together multi-disciplinary team of chemists, physicists, materials scientists and computer scientists towards establishing and running an SDL at AFRL, and at the same time accelerating Air Force research efforts towards enabling new technologies.

- 5. Research Classification/Restrictions:** Ability to obtain clearance for the DAF (must be a U.S. citizen)
- 6. Eligible Research Institutions:** Open to all Ohio-based academic institutions.
- 7. PA Approval Number: AFRL-2026-3944**