

Research Title: Organic materials for robust electronic interfaces with gallium liquid metal alloys

1. **Individual Sponsor:** List the AFRL research topic sponsor's contact information

Dr. Christopher E Tabor, AFRL/RXAP
3005 Hobson Way
Wright Patterson, OH 45433
christopher.tabor.1@us.af.mil

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

Material Science and Engineering
PhD candidate level

3. **Objectives:** Identify and characterize various organic electronic materials that can serve as robust electrical contacts for gallium liquid metal alloys.

4. **Description:** Gallium liquid metal alloys (GaLMAs) present a new class of materials that are conductive room temperature fluids and can be utilized in reconfigurable and flexible electronic architectures. One of the fundamental hurdles of realizing fully integrated microfluidic GaLMA components is the lack of reliable and robust electrical contacts for the liquid metal alloys. Traditional inorganic electronic materials used for contact pads and electrical leads readily alloy with GaLMA materials, leading to catastrophic changes in the physical properties of the GaLMA fluids, resulting in loss of reconfigurable and flexible attributes of the GaLMA paradigm as well as corrosive and irreparable damage to electrical function. There is a great opportunity to explore novel organic materials to serve as electrical contacts for GaLMA materials, such as pi-conjugated polymers and various allotropes of carbon, including but not limited to forms of carbon nanotubes and graphene. The research should encompass correlating common device metrics (such as connection switching speeds, contact resistance, power handling, life-time reliability) on physical and chemical properties of the GaLMA / electrode interface, such as work function modification, Fermi levels, surface energy, surface structure, GaLMA composition, etc... A complete understanding of these interfaces and how they are affected by operational environments, such as low oxygen levels in hermetically sealed devices and operating temperatures from -60C to 150C, will provide enormous benefit to utilizing GaLMA materials in flexible and reconfigurable electronics in Air Force and commercially relevant applications.

5. **Research Classification/Restrictions:** The work to be carried out under this effort is unclassified and not restricted.

6. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided



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