Title: The Role of Sulfonolipids in Iridescent Biofilms of *Cellulophaga lytica*

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Iridescent mollusk shells and morpho butterfly wings are examples of natural optical materials which derive their coloration from hierarchical assemblies. Such structural colors are generated when light interacts with repeating nanostructures, provided a refractive index contrast exists between them and the intervening material. Without sufficient contrast, light passes through the nanostructures failing to generate these optical effects. While replicates of nature's complex designs have been realized in prototypical materials, manufacturing at scale remains a major bottleneck. Owing to their ability to self-assemble over large length scales, structurally colored *C. lytica* biofilms may circumvent challenges hindering the manufacture of ordered materials. However, a fundamental understanding of color generation is needed including identification of the cellular components contributing to the biofilms' iridescence. Gram negative bacteria, including *C. lytica*, have a layered structure where a thin peptidoglycan is sandwiched between two membranes. Each layer is chemically distinct and could be the source of the requisite refractive index mismatch in iridescent biofilms. Given their position in the outer membrane of the unit cell and their unique association with gliding bacteria, sulfur-containing lipids will be investigated in this LUCI project. They will be characterized and the genes required for their biogenesis will be identified. Importantly, the impact of sulfonolipids on the optical properties of iridescent biofilms will be determined.

Significance: New classes of materials that are multi-scaled, lightweight, thermally insulating, selectively reflective, and tough offer superior, multi-functional performance for military applications. Complex combinations of such properties can be achieved in materials via hierarchical assemblies. Ordered biofilms can be a generalizable platform for developing optical and templated hierarchical materials which are amenable to manufacturing at industrial scales. The ability to tailor biofilm properties for military relevant applications will be possible through genetic engineering approaches once relevant cellular components are known.