QUANTUM TECHNOLOGIES, METAMATERIALS, AND THE FUTURE OF CB SENSING

Hydrogel Technology for Emerging Colorimetrics (HyTEC): Metamaterials and Peptide Recognition Elements Combined for Eye-Readable Sensors

Joseph Palomba U.S. Army DEVCOM Soldier Center **Ken Ngo** U.S. Army DEVCOM Soldier Center **Timothy Lawton** U.S. Army DEVCOM Soldier Center **Kelsey Snapp** U.S. Army DEVCOM Soldier Center **Victoria Ayotte** U.S. Army DEVCOM Soldier Center

Colorimetric sensing for chemical and biological threats has been dominated by color-changing dyes that lack specificity and shelf-stability. Using established techniques for fabricating metamaterials that interact with visible light, new sensors can be developed that do not rely on reactive dyes. Photonic crystals are an example of a metamaterial where periodic structure creates destructive interference of white light resulting in reflectance of specific wavelengths giving rise to color. In a 3D photonic crystal this interference pattern and resulting color can be changed by altering the lattice spacing. Our work seeks to induce this lattice change by encapsulating a photonic crystal in a responsive hydrogel that can be triggered by analyte of interest. The combination of 3D photonic crystal in a responsive hydrogel would result in an eye-readable colorimetric sensor that can be tailored to a number of chemical and biological threats.

This project combines expertise in metamaterials, hydrogels, peptide receptors, and machine learning to develop a platform for colorimetric sensors for toxic chemical and biological compounds. The sensing elements are constructed from peptide recognition elements called Protein Catalyzed Capture agents (PCCs) that bind selectively to proteins and other biopolymers. These PCCs consist of a loop with five amino acids that can be made into large screening libraries both experimentally and computationally. With high-throughput compound libraries and in-silico screening aided by Bayesian optimization, a range of threats with different chemical structures are targeted. Prototype sensors will be tested in an autonomous environmental chamber that can take pictures and spectra of the color change events at different temperatures and humidities.

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