UNIVERSITÀ DEGLI STUDI DI BRESCIA

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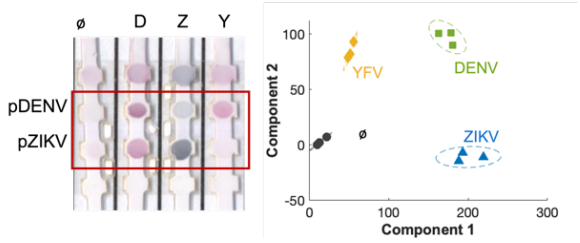

Rapid Diagnostics for Infectious Diseases Using Gold Nanoparticles

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The global COVID-19 pandemic has underscored the need for innovations in disease diagnostics. Paper immunoassays, such as lateral flow assays, have been a critical tool for infectious diseases. These assays are low-cost, can be used in rugged environments, and possess sample-to-answer times of minutes, so they are attractive for widespread deployment for disease surveillance, quarantining, and treatment. Biological fluids such as blood or saliva is added to the paper strip, which wicks through. Readout by eye is made possible by the gold nanoparticles, absorb light strongly due to their surface plasmon resonance. We are developing novel ways to use immunoassays beyond conventional use cases. Specifically, we are using them as selective multidimensional sensors, and exploiting the unique size and material dependent properties of the nanoparticles in the assay. By doing so, we can repurpose antibodies raised for one target (dengue and zika viruses) to construct an assay for another (yellow fever virus) by using gold nanoparticles of different colors and machine learning of the test lines colors. In addition, we can hack existing diagnostics to detect other targets of interest. We are creating adaptive SARS-CoV-2 assays that can detect and distinguish emerging variants without the need for raising new antibodies for every variant. We also discuss challenges associated with the biotic-abiotic interface in paper based immunoassays, which result in undesirable side effects such as non-specific adsorption and false positives.

Kimberly Hamad-Schifferli is a Professor in the Department of Engineering and the School for the Environment at University of Massachusetts Boston. She obtained her S.B. in Chemistry from MIT and Ph.D. in Chemistry from the University of California at Berkeley. She was a faculty member at MIT in the Depts. of Mechanical Engineering and Biological Engineering from 2002-2012. Since 2015 she has been a faculty member at UMass Boston. She received an ONR Young Investigator Award and was named a Fellow of the Foresight Institute in 2017. Her research is focused on using nanotechnology for biological applications, such as infectious disease, cancer therapy, and food safety.
Her research lab has launched low cost sensors to the International Space Station, given them to farmers and community members in Vieques, Puerto Rico, and tested wild migratory birds on the coast of Massachusetts. Their work has been covered in news articles such as The New York Times, Scientific American, and Technology Review.
https://news.mit.edu/2015/ten-minute-ebola-test-0224
https://spmt.umb.edu/news/2020/engineering-professor-has-developed-procedure-that/

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