VIDEO ARTICLE

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Emerging COVID-19 Diagnostics from Molecular Targeting to Digital Detection

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Abstract

Nanoscale structures offer unprecedented potential in pre-emptive medicine covering early detection, diagnosis and therapy of diseases. Pan Lab@Illinois (and now @UMaryland) advances translatable technologies for human health by uniquely merging 'molecule making' and 'device making' through innovations in molecular imaging, point-of-care biosensing [**1-16**] and machine learning tools.

Since the first case of COVID-19 was reported in the United States (U.S.) on January 21st, 2020, it has already been ascertained to affect >52M active cases with >1.3M deaths. Currently, COVID-19 is being diagnosed primarily by three techniques, i.e., reverse-transcription polymerase chain reaction (RT-PCR), gene sequencing and chest computed tomography (CT). However, limitations of sample collection and transportation, as well as kit performance with inadequate access to advanced instrumental techniques, often cannot report COVID-19 at its initial presentation leading to the spread of this infectious disease to a wider community. Moreover, researchers found at least three central variants, distinguishable by amino acid changes, among 160 different complete human SARS-CoV-2 genome sequences. This limits the universal applicability of the currently available commercial COVID-19 kits. Pan Research Group at Maryland has been developing novel approaches for screening of active COVID-19 cases with plasmonic [**17**] and other quantitative biosensing techniques [**18**]. These unique approached for selective sensing of SARS-CoV-2 eliminates the possibility of misinterpretation arisen due to the genomic variants of this virus which is the most concerning limitation of the current COVID-19 sensing kits. We anticipate that our sensing approaches can detect the specific target nucleic acid sequences without signal cross talk with a detection limit to a single virus level with time of response to be around 2-3 mins.

Key words: Nanomedicine, COVID-19, point-of-care, biosensing, genetic material.

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Biography of Presenting Author

Dipanjan Pan, MS, PhD, is an expert in nanomedicine, molecular imaging, drug delivery and biosensing. He is presently a tenured Full Professor in Diagnostic Radiology & Nuclear Medicine, Pediatrics and Chemical, Biochemical and Environmental Engineering in University of Maryland Baltimore School of Medicine and University of Maryland Baltimore County. Prior to moving to Maryland, he was a tenured Associate Professor and Associate Head of the department in Bioengineering and Materials Science and Engineering and Institute of Sustainability in Energy and Environment in University of Illinois, Urbana-Champaign. He administratively directs the Nanofabrication and Characterization Core at CBOTH and a Director for the Investigational Probe Design Resources in Radiology.

Prof Pan's lab uniquely merges fundamental chemistry, biology and engineering to bring solution to today's healthcare problems. His research is highly collaborative and interdisciplinary centering on the development of novel materials for biomedical applications, immune-nanomedicine and targeted therapies for stem-like cancer cell with phenotypically screened nanomedicine platforms and biosensing approaches for infectious diseases. Over the years, this research has resulted in more than 200 high impact peer reviewed publications in scientific journals, numerous conference abstracts and has been supported by multimillion-dollar external funding from NIH, NSF, DoD, American Heart Association and other private/foundational funding sources. He has mentored more than 15 postdoctoral scientists, 14 MS/PhD students and >30 undergraduates in his laboratories.

Prof. Pan edited and co-written two books published from Taylor and Francois (Nanomedicine: A Soft Matter Perspective, ISBN-13: 978-1466572829) and Springer (Personalized Medicine with a Nanochemistry Twist: Nanomedicine (Topics in Medicinal Chemistry, ISBN-13: 978-3319335445). He holds multiple patents (>20 US granted patents and applications), numerous invention disclosures several ongoing clinical trials. He is the founder of three University based early start-ups. He is the CEO/President for a biotechnology start-up Vitruvian Bio, dedicated to developing novel image guided therapies. He co-founded InnSight Technologies dedicated to developing next generation biosensing solution for ocular diseases. His other company KaloCyte, Inc, which he cofounded with his clinical collaborators, develops artificial oxygen career. He acts as a Chief Technology Officer for all the spin-offs from his lab. His technology has been licensed for commercial development multiple

times. He serves as study section review board member for NIH, CDMRP (DoD), NSF and multiple review committee member for American Heart Association. In 2016 he received Nanomaterials Letter (NML) Researcher award, in 2017 a Young Innovator Award from Biomedical Engineering Society (BMES) and a Deans Award for Research Excellence in 2018. He is an elected fellow of Royal Society of Chemistry, a Fellow of American Heart Association and an elected fellow of American College of Cardiology. Professor Pan is an Associate Editor for WIRES Nanomedicine and Nanobiotechnology, and an editorial advisory board member of Molecular Pharmaceutics (ACS).

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