

Chemical Engineers in Medicine 2022

Topical Conference at the 2022 AIChE Annual Meeting

Phoenix, Arizona, USA
13-18 November 2022

ISBN: 978-1-7138-7915-2

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2022) by AIChE
All rights reserved.

Printed with permission by Curran Associates, Inc. (2023)

For permission requests, please contact AIChE
at the address below.

AIChE
120 Wall Street, FL 23
New York, NY 10005-4020

Phone: (800) 242-4363
Fax: (203) 775-5177

www.aiche.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

CHEMICAL ENGINEERING PRINCIPLES ADVANCING MEDICINE II

153e Genetically Stable CRISPR-Based Kill Switches for Engineered Microbes	1
<i>Austin Rottinghaus, Aura Ferreiro, Gautam Dantas, Tae Seok Moon</i>	
219b Virus Encapsulation in Polypeptide Complex Coacervates for Vaccine Formulations.....	3
<i>Caryn Heldt, Pratik Joshi, Claire Decker, Xianci Zeng, Arvind Sathyavageeswaran, Sarah Perry</i>	
219c Association and Adsorption of Mucins to the Air Interface in Human Airway Mucus.....	4
<i>Scott Danielsen, Richard C. Boucher, Michael Rubinstein</i>	
219d Computational Fluid Dynamics to Understand Ureteroscopy Irrigation	5
<i>David G. Foster</i>	
219e Validation of Stroke Prediction in Patients with Carotid Artery Disease Using CFD.....	7
<i>David G. Foster, Lauren Redus</i>	
219f A Computational Predictive Framework Towards Individualized Risk Assessment of Kidney Transplantation Failure.....	9
<i>Symeon Savvopoulos, Andreas I. Reppas, Wilfried Gwinner, Irina Scheffner, Haralampos Hatzikirou</i>	
219g Monte Carlo Simulations of Spherocylinders Interacting with Site-Dependent Square Well Potentials	11
<i>Kiranmai Yellam, Prateek Jha</i>	

MEDICAL DEVICES

89a Low-Level Metal Toxicology in Serum Via Anodic Stripping Voltammetry.....	12
<i>Shaylee R. Larson, Mary Jeppson, Kevin Chandler, Paige Leland, Himanshu Sant, Swomitra Mohanty</i>	
89b Comparison of Methemoglobin and Deoxyhemoglobin As Potential Contrast Agents in Magnetic Resonance Imaging (MRI)	14
<i>Royaalsadat Ayati, Kyle Manwaring, Randy S. Lewis</i>	
89c Barrier-Free Paper Analytical Devices for Multiplex Colorimetric Detection	15
<i>Ayushi Chauhan, Bhushan Toley</i>	
89d Clinical Validation of Breath Biomarkers in Pediatric Tuberculosis Patients Using Comprehensive Two-Dimensional Gas Chromatography Time-of-Flight Spectrometry	17
<i>Mary Jeppson, Emily Lym, Swomitra Mohanty</i>	
89e Elucidating the Effects of Shear and Surface Topography on Thromboembolism in Ventricular Assist Devices	19
<i>Anjana Jayaraman, Junhyuk Kang, James Antaki, Brian J. Kirby</i>	
89f Active Levy Swimmers and Geometric Design for Anti-Infection Catheters	22
<i>Tingtao Zhou</i>	

89g A Low Cost, Compact Flow Cytometer.....	23
<i>Mahrukh Mir, Mahesh S. Tirumkudulu</i>	

CHEMICAL ENGINEERING PRINCIPLES ADVANCING MEDICINE I

153a Slow-Release Nanoparticles for Chronic Pain Management	24
<i>Parker Lewis, Rachel Pollard, Rocco Latorre, Dane Jensen, Brian Schmidt, Nigel Bunnett, Nathalie M. Pinkerton</i>	
153b Pseudomonas Aeruginosa Reverse Diauxie Is a Multidimensional, Optimized, Resource Utilization Strategy Facilitating Chronic Wound Colonization	25
<i>S. Lee McGill, Yeni Yung, Kristopher A. Hunt, Michael Henson, Luke Hanley, Ross P. Carlson</i>	
153d Evaluating Antimicrobial Drug Formulations on a 3D Biofilm Growth Model Under Simulated In Vivo Conditions	26
<i>Yadiel Varela-Soler, Himani Chavda, Swarnima Roychowdhury, Veronica Farag, Patrick Erickson, Biju Parekkadan, Charles Roth</i>	
153f Improving Therapeutic Protein Secretion in Probiotic Yeast <i>Saccharomyces Boulardii</i> using a Multifactorial Engineering Approach.....	27
<i>Deniz Durmusoglu, Ibrahim Al'Abri, José Luis Martinez Ruiz, Nathan Crook</i>	
153g A Low-Cost Strategy for Genotypic Antimicrobial Resistance Detection Using Oligonucleotide Ligation Assay	28
<i>Ayushi Chauhan, Bhushan Toley</i>	

ENGINEERING CANCER I: MECHANISTIC STUDIES

526a The Effects of Intratumoral Heterogeneity on Metastasis of Triple-Negative Breast Cancer Cells.....	30
<i>Molly Brennan, Susan E. Leggett, Sophia Martinez, Celeste M. Nelson</i>	
526b The Effects of Palmitate-Induced IRE1 α Activation in DNA Double Strand Break Repair and the Development of Chemotolerant Breast Cancer Cells	31
<i>Kevin Chen, S. Patrick Walton, Christina Chan</i>	
526c Macrophages Aggregate and Cooperate to Phagocytose Cohesive Tumor Cell Targets in Engineered Immuno-Tumoroids and Solid Tumors	32
<i>Lawrence J. Dooling, Jason C. Andrechak, Brandon H. Hayes, Siddhant Kadu, Dennis E. Discher</i>	
526d Mechanistic Characterization of Homologous Recombination in BRCA2 Mutant Cancers	33
<i>Shayne Sensenbach, Prashant Karki, Mehmet Orman</i>	
526e Modeling Cancer Dormancy and Recurrence with the Theory of Birth-Death Processes	34
<i>Adeyinka Lesi, David Rumschitzki</i>	
526g Machine-Learning Based Prediction of Membranolytic Peptides with Anticancer Activities.....	35
<i>Atefe Alimirzaei, Christopher Kieslich, Hyeju Song</i>	
526h Caspase-Dependent HDAC4 Translocation Due to Microsecond Pulsed Electric Field (μ sPEF) Exposure of Glioblastoma Cells.....	36
<i>Zahra Safaei, Gary Thompson</i>	

TISSUE ENGINEERING, BIOPRINTING, AND REGENERATIVE MEDICINE

471a Mitochondrial Mechanisms Underlying NANOG Induced Reversal of Aging	39
<i>Debanik Choudhury, Na Rong, Nika Rajabian, Georgios Tseropoulos, Pihu Mehrotra, Ramkumar Thiyagarajan, Pedro Lei, Izuagie Ikhapoh, Kenneth Seldeen, Bruce Troen, Stelios Andreadis</i>	
471b Effects of Processing Conditions on the Macroscopic Properties of Cellulose Filled Hydrogel Scaffolds Using UV Rheology	40
<i>Bobby Haney, Subramanian Ramakrishnan</i>	
471c 3D Bioprinting of iPSC Derived Islet Organoids in Hydrogel Constructs	41
<i>Miranda Poklar, Ben Mizerak, Ravi Krishnamurthy, Connor Wiegand, Prashant Kumta, Ipsita Banerjee</i>	
471d Engineering the Skeletal Muscle for Improved Innervation after Peripheral Nerve Injury	43
<i>Pihu Mehrotra, Shahryar Shahini, Nika Rajabian, Yali Zhang, Jianmin Wang, Song Liu, James Jablonski, Susan Udin, Stelios Andreadis, Kirkwood Personius</i>	
471e Regeneration of the Epithelium Layer Using Fibrous Biomimetic Basement Membranes in a Mouse Dermal Wound Model	44
<i>Dina Gadalla, Maeve Kennedy, David Lott</i>	
471f Photochemical Reaction Kinetics and Thermodynamics of Light-Induced Collagen Cross-Linking with Rose Bengal for Suture-Less Wound and Incision Closure and Repair	46
<i>Alan Aguirre-Soto</i>	

BIG DATA AND MACHINE LEARNING TO ADVANCE MEDICINE

284a Data-Driven QSAR Modeling for the Iterative Identification of Chemical Motifs from Limited Data	47
<i>Hyun-Seob Song, Chul Min Park, Soojin Jang, Jae Sun Kim, Hyung Chul Ryu, Hasoo Seong</i>	
284b Single Sequence Prediction of Protein Structure and Impacts on Computational Protein Design.....	48
<i>Ratul Chowdhury</i>	
284c Hierarchical Graph-Based Representation Drives Prediction of Stapled Peptide Drug-like Properties.....	49
<i>Marshall Case, Camille Bilodeau, Greg Thurber</i>	
284d Data-Driven Approach for the Prediction of MHC Class II Epitopes Using Oscillations of Physicochemical Properties.....	52
<i>Hyeju Song, Christopher Kieslich</i>	
284e Automated Detection of Apoptotic Bodies in Label-Free Time-Lapse High-Throughput Microscopy Using Deep Convolutional Neural Networks	53
<i>Kwan-Ling Wu, Melisa Martinez-Paniagua, Kate Reichel, Prashant Menon, Shravani Deo, Badrinath Roysam, Navin Varadarajan</i>	
284f Single-Cell Transcriptomic Analysis of Neural Development	54
<i>Karthik Shekhar</i>	

284g Structure-Guided Functional Phylogenetic Trees of Human Channel Proteins and Kinases for Drug Discovery	55
<i>Ratul Chowdhury</i>	

284h Machine Learning Enabled Cancer and Immune Cells Segmentation on Clinical Images.....	56
<i>Vidit Shah, Felicia Poynter, Shachi Mittal</i>	

PANDEMIC RESPONSE AND PUBLIC HEALTH

348a Indoor Transport of Aerosolized Respiratory Droplets in Multiroom Buildings	58
<i>Alex Vlachokostas, Timothy Salsbury, Carolyn A. Burns, Leonard Pease</i>	
348b Multi-Strain Integrated Modelling for COVID-19	59
<i>Dimosthenis Sarigiannis, Achilleas Karakoltzidis, Spyros Karakitsios</i>	
348c Portable and Label-Free Quantitative Loop-Mediated Isothermal Amplification (LF-qLamp) for Reliable COVID-19 Diagnostics in Three Minutes of Reaction Time.....	62
<i>Sergio Bravo-González, Grissel Trujillo De Santiago, Mario Moisés Álvarez</i>	
348d Affordable Rapid PCR-Based Biodetection at the Point of Care Via Rayleigh-Bénard Convection.....	63
<i>Mingin Kim, Victor Ugaz</i>	
348f Rapid Bioproduction of Protein Biologics Using Plants in Response to Sars-Cov-2.....	64
<i>Katherine Haddad, Seongwon Jung, Imran Khan, Nancy E. Lane, Somen Nandi, Karen A. McDonald</i>	
348g Strategic Planning of Joint COVID-19 Booster and Influenza Vaccination Campaign: The UK COVID-19 Pandemic Study	66
<i>Dauda Ibrahim, Zoltán Kis, Maria Papathanasiou, Cleo Kontoravdi, Benoit Chachuat, Nilay Shah, Miriam Sarkis</i>	

ENGINEERING CANCER II: THERAPY

573a Low Doses of Paclitaxel Induce a Dormant State in Brain Metastatic Breast Cancer Spheroids	68
<i>Raghav Vamsi Kondapaneni, Rachel Warren, Shreyas Rao</i>	
573b Engineer CAR-Neutrophils for Targeted Cancer Immunotherapy	69
<i>Xiaoping Bao</i>	
573c Immunogenic Treatment for Metastatic Breast Cancer Using Targeted Carbon Nanotube Mediated Photothermal Therapy in Combination with Anti-PD-1	70
<i>Gabriela Faria, Alexis Woodward, Clément G. Karch, Adam Aissanou, Roger Harrison</i>	
573d Immune Cell Homing Materials for Cancer Immunotherapy.....	72
<i>Hua Wang</i>	
573e Electroporation and Cold Atmospheric Plasma As a Novel Cancer Treatment	73
<i>Jordan Hoops, Kristen I. Haller, Mikaya M. Elliott, Rylie N. Andrews, Nicole Miller, Timothy Brenza, Prasoon K. Diwakar</i>	
573f Combined Gene and Chemotherapy for Cancer: Interdisciplinary Multimodal Approaches to Effective, Safe, and Diverse Therapies.....	74
<i>Rebecca Lee, Cheng Wai "winne" Lei, Margaret Lugin, Jee Young Chung, Woo Chang Hwang, Angela G. Fleischman, Namshik Han, Young Jik Kwon</i>	

573g The Landscape of Drug Sensitivity in Cancer Cell Lines Reveals Effective Drug Combinations for Cancer.....	75
<i>Belinda Garana, Nicholas Graham</i>	
573h Multi-Modal Single-Cell Characterization As a Basis for Precision Therapy for Intratumoral Heterogeneity in Glioblastoma.....	76
<i>James Park, Abdullah Feroze, Samuel Emerson, Anca Mihalas, C. Keene, Patrick Cimino, Adrian Lopez Garcia De Lomana, Wei-Ju Wu, Serdar Turkarslan, Kavya Kannan, Nitin Baliga, Anoop Patel</i>	

INFECTION AND PREVENTION, EPIDEMIOLOGY AND TREATMENTS, DIAGNOSTIC APPROACHES

417a Two Complementary Memory B Cell Processes Generate Antibody Protection Against the Same or Variant Viruses.....	77
<i>Matthew Vanbeek</i>	
417b A Model for How T Cell-Mediated Autoimmunity Can be Triggered By Persistent Viral Infections.....	78
<i>Rose Yin, Samuel Melton, Eric Huseby, Mehran Kardar, Arup K. Chakraborty</i>	
417c Predicting the Effects of Sars-Cov-2 Spike Protein Mutations to MHC Class II – Mediated Immune Responses.....	79
<i>Mercedes Haley, Sumaiya Islam, Robert Pantazes</i>	
417d Inhibition of Sars-Cov-2 Spike Protein Pseudotyped Virus Infection Using ACE2-Tethered Micro/Nanoparticles	80
<i>Soha Alkhaldi, Ian Peng, Esmael Alyami, Ammar Ahmad Tarar, Ching-An Peng</i>	
417e A Novel SERS-Based Assay for Detection of the Sars-Cov-2 Spike Protein	81
<i>Karen Wawrousek, Moein Mohammadi, Delphine Antoine, Madison Vitt, Sharmin Sultana Jyoti, Julia Dickie, Gerard Wall, Patrick A. Johnson</i>	
417f Cell-Free, Dendritic Cell-Mimicking Vaccines for Cancer, COVID-19, and Beyond	82
<i>Melissa N. Thone, Jee Young Chung, Young Jik Kwon</i>	
417g Agent-Based Modeling of Sars-Cov-2 Transmission during the COVID-19 Pandemic at the University of Delaware.....	83
<i>Soham Jariwala, Norman J. Wagner, Antony Beris, Richard Suminski, Gregory Dominick</i>	

ENGINEERING CANCER III: DEVICES FOR DIAGNOSIS, CULTURING, AND MICROENVIRONMENT STUDIES

616a Nature-Inspired 3D Scaffolds to Improve Ex Vivo T-Cell Culturing Environments for Adoptive Cell Transfer Cancer Immunotherapy.....	85
<i>Lucy Todd, Matthew Chin, Marc-Olivier Coppens</i>	
616b Isolation and Identification of Subpopulations of Circulating Tumor Cells Using a Microchip with Bio-Inspired Patterns	86
<i>Wei Li, Zhenya Ding</i>	
616c Dynamic 3D Co-Culture of Stromal and Immune Cells with ER ⁺ Breast Cancer Using a Thiol-Acrylate Hydrogel Scaffold and Microfluidic Droplet Trapping Array.....	88
<i>Braulio Ortega Quesada, Anowar H. Khan, Sophia Zhou, Elizabeth C. Martin, John Pojman, Adam Melvin</i>	

616d Cell-Free Protein Synthesis Biosensing of Glutamine in Human Serum and Saliva: Towards at-Home Low-Cost Diagnostics for Personalized Cancer Treatment	89
<i>Brad Bundy, J Porter Hunt, Mehran Soltani</i>	
616e Investigating Intracellular Adhesion and Intercellular Signaling in Glioblastoma Models	90
<i>Rosalyn Hatlen, Padmavathy Rajagopalan</i>	
616f Probing the Spatiotemporal Attributes of Gamma-Secretase/Notch Signaling in Breast Cancer Microenvironments.....	92
<i>Malcolm Lane Gilchrist, Yueming Li</i>	
616g Multivariate Model of an Engineered Niche Delineates Metastatic Potential of Breast Cancer	93
<i>Sophia Orbach, Christian Devaull, Elizabeth Bealer, Jacqueline Jeruss, Lonnie Shea</i>	
616h Multimodal Imaging for Simultaneous Measurement of Melanocyte Mass and Pigmentation	96
<i>Tarek Moustafa, Edward Polanco, Rachel Belote, Robert Judson-Torres, Thomas Zangle</i>	

Author Index