## ETHzürich

ICB seminar series 2023/24 chairman: Prof. Dr. Gonzalo Guillén-Gosálbez

## SELF-DRIVING LABS IN NANOCHEMISTRY AND MEDICINE

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Abstract: This lecture highlights our recent progress in the design, development, and applications of self-driving labs in the synthesis of nanoparticles and in drug screening. With regards to the nanochemistry, we developed an Autonomous Fluidic Identification and Optimization Nanochemistry (AFION) self-driving lab that integrated a microfluidic reactor, in-flow spectroscopic nanoparticle characterization, and machine learning for the exploration and optimization of the multidimensional chemical space for the photochemical synthesis of metal nanoparticles. By targeting specific spectroscopic nanoparticle properties, the AFION lab successfully identified reaction conditions for the synthesis of different types of nanoparticles with designated shapes, morphologies, and compositions. Data analysis provided insight into the role of reaction conditions for the synthesis of the targeted NP type and the impact of a specific condition on nanoparticle quality. Another research direction involved integration of machine learning with a tumor-on-a-chip microfluidic platform. We combined large arrays of cancer organoids grown in a biomimetic gel, microfluidics, and machine learning to discover new or optimize existing regimens for multidrug administration for cancer chemotherapy. Based on the organoid response to drug tretment, the machine learning algorithm adaptively learned to propose drug combinations and administration regimens with higher and higher efficacy, thus, leading to the decision-making step about effective therapy. The approach aims to provide advances in cancer treatment in a highly personalized manner.

Bio: Eugenia Kumacheva is a Professor of Chemistry at the University of Toronto and a Canada Research Chair in Advanced Functional Materials. Her research interests span across the fields of fundamental and applied polymers science, nanotechnology, microfluidics, and interface chemistry. She was awarded the L'Oréal-UNESCO Awards for Women in Science in 2008 and in 2011, she co-authored a book titled "Microfluidic Reactors for Polymer Particles". She is currently a tier 1 Canadian researcher in Advanced Polymer Materials and also a Fellow of the Royal Society of Canada and Royal Society (UK).



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