Warsaw Doctoral School in Natural and Biomedical Sciences and the Institute of Physical Chemistry PAS cordially invite you to an **ADVANCED LECTURE SERIES – BIO-INSPIRED CHEMISTRY** talk**.**

Structure-Switching DNA Aptamers for Chemical Biosensing

given by

Dr Nako Nakatsuka
Institute for Biomedical Engineering, ETH Zürich, Switzerland

on 26th October 2023, 10:00 at IChF Aula
Duration: 45 min + question time

Highly recommended to all Warsaw-4-Phd students!

Nature designed small molecules to regulate a vast array of biological mechanisms. Drugs, that are also often small molecules, have been developed to target dysregulation in human biology. Therefore, there is a critical need to monitor small molecules to both understand complex biological systems and to tackle diseases. However, many small-molecule biosensors fail in physiologically relevant biofluids found in the human body, like blood, urine, saliva, or sweat. The inherent challenges of biological environments include the high concentrations of ions (that conceal specific binding events unless the targeted interaction occurs near the sensor surface) and the propensity for false positive signals (due to nonspecific binding of proteins that exist in orders of magnitude higher amounts than the target of interest). Our work overcomes these conventional limitations of small-molecule sensing by harnessing aptamers, or artificial DNA-based recognition elements, which can be systematically designed to capture diverse small molecules such as neurotransmitters, amino acids, sugars, lipids, and steroids. Importantly, we work with structure-switching aptamers that undergo a significant rearrangement of their negatively charged backbone. These structural changes can be transduced as measurable changes when interfaced with electronic platforms. In this talk, I will demonstrate how transducers ranging from the microscale (field-effect transistors) to the nanoscale (nanopipettes with diameters ~10 nm) can be used to monitor real-time flux of neurotransmitters (dopamine and serotonin) from *in vivo* (awake mice)*, ex vivo* (brain slices)*,* and *in vitro* (human neurons) systems. Extensive experimental and theoretical characterization of the target-specific aptamer conformational dynamics have led to a fundamental understanding of the mechanisms of our biosensing technologies. Such findings enable generalization of our strategy to monitor hypothetically, any small-molecule analyte of interest.

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BIOGRAPHY

Dr. Nako Nakatsuka is a senior scientist at the Laboratory of Biosensors and Bioelectronics at the ETH Zürich. She was raised in Tokyo, Japan and moved to the U.S.A. for her Bachelor's in Chemistry at Fordham University (Bronx, NY) and pursued her Ph.D. at UCLA (Los Angeles, CA). Upon receiving the prestigious ETH Zürich postdoctoral fellowship, she moved to Switzerland and now leads a team focused on interfacing DNA-based receptors (aptamers) with nanoscale electronic biosensors to detect diverse small molecules such as neurotransmitters. For this work, she was named an MIT Under 35 Pioneer in 2021, received the iCanX Young Scientist award in 2022, and the ACS Nano Lectureship award in 2023. She has mentored over 40 B.S., M.S., and Ph.D. students at the ETH Zürich in diverse projects beyond small-molecule biosensing.

Dr. Nakatsuka is also passionate about social justice, outreach, and education. She was awarded the Norma Stoddart Prize for Academic Excellence and Outstanding Citizenship in 2018 for her contributions in community outreach combined with her scientific achievements. She also received the Hanson-Dow Excellence in Teaching Award for her exceptional teaching and dedication to students in 2015. She is currently an active member of the Diversity Team at ETH and has contributed to initiatives that raise awareness and spark discussion about anti-discrimination within Switzerland. She has also illustrated a children's chemistry book: "A is for Atom: ABCs for Aspiring Chemists".