ABSTRACT

High energy consumption and low-efficiency performance have been long-standing pivotal problems for wastewater treatment plants. These systems are operated like "Black Boxes" and monitored using "single point" probes without a complete picture of operational status and in situ waste quality. Energy-positive resource recovery has been regarded as the future of wastewater treatment plants. In order to achieve this initiative, game-changing actions should be undertaken to convert existing the "local and limited" monitoring and passive control pattern to panoramic high-resolution profiling and intelligent operational methodology. The research presented focuses on developing state-of-the-art sensing technology: flat thin solid-state mill-electrode array (MEA) sensors and solid-state ion selective membrane (S-ISM) nitrogen sensors for real-time in situ water quality monitoring. Specifically, MEA consists of multiple types of mm-sized sensors electrodes (e.g., dissolved oxygen, pH and conductivity) and enables profiling heterogeneity in systems at an unprecedentedly high spatiotemporal resolution. S-ISM nitrogen sensors effectively solve the essential problems of existing water sensors: low accuracy and short lifespan. Mass deployment of these low cost and durable sensors will obtain high-fidelity datasets, reveal the complete picture of system heterogeneity, detect and isolate faults within the systems, and ultimately alleviate system uncertainty. The seminar will have three parts. Part 1 will be S-ISM nitrogen sensor development and the progress from lab tests to field demonstration tests. Part 2 will be high-resolution profiling using the MEA sensors in a reactor and data-driven model development based on sensor data. Part 3 will be the vision of intelligent water infrastructure through next generation sensing and modeling methodologies. The innovative solutions ranging from mm-sized S-ISM sensors and MEAs with high accuracy and long-term stability (improved real-time in situ monitoring), high-fidelity profiling of system heterogeneity (improved process understanding), and data-driven rigorous modeling (improved process resilience and stability) presented in this seminar will have a great potential to transform energy-intensive, inefficient and unstable water infrastructures to accurately control energy-saving "intelligent dynamic robust sys-

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