



Wolfson Department of Chemical Engineering Seminar

Monday, May 18th, 2026 at 13:30

Room 6

Elucidation of Surface Science Phenomena in Catalytic Reactions and Organic Crystal Polymorphism Investigation via ex- and in-Situ High-Resolution TEM

Dr. Idan Biran

Department of Physics, Technical University of Denmark

Transmission electron microscopy (TEM) has entered a transformative era, yet the field still operates within a fragmented landscape where techniques are often deployed in isolation and electron-dose budgets are treated as constraints rather than design parameters. This presentation details the development of integrated, dose-aware ex- and in-situ platforms designed to redefine the methodology for investigating sensitive materials. By coordinating multiple modalities, including open and closed gas-cell TEM, 4D-STEM, and low-dose focal-series reconstruction (LD-FSR), a framework that preserves the chemistry governing material reactivity and its native state during high-resolution imaging can be established.

The first part will focus on fundamental work in a state-of-the-art environmental TEM (ETEM) for catalytic systems under realistic conditions. A method to inspect the information limit at a gas pressure of 1 mbar (ca. seven orders of magnitude higher than for a standard TEM) will be shown. Furthermore, a demonstration of the focal series reconstruction (FSR) technique while using the ETEM will be presented, including the achievement of ca. 50 pm resolution under gas exposure with a monochromated Nelsonian illumination. This capability facilitated the direct observation of sub-angstrom interactions between gas molecules and gold nanoparticle surfaces, revealing distinct atomic column broadening that indicates gas-catalyst interaction. Later, our development of low-dose FSR will be discussed, showing how the technique can be used for near-atomic-resolution imaging and real-space crystallography of organic materials, overcoming the size limitations of X-ray diffraction. The last part of the talk will include a short introduction to 4D-STEM alongside results of its use while complementing other imaging techniques, specifically for organic crystalline polymers.

Refreshments will be served at 13:15.