INTERDISCIPLINARY CENTRE FOR ADVANCED MATERIALS SIMULATION

ICAMS Special Seminar

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Size effects in the mechanical behavior of nanoporous gold

Nanoporous metals are an exciting new class of material having remarkable physical and chemical properties with potential applications such as electrochemical actuators, catalysts, biological sensors, and electrodes for fuel cells. Their remarkable physical and chemical properties owe to the nanoscale open porous structure, abundance of surfaces, and nanoscale structural dimensions. Nanoporous gold (np-Au) is the most widely studied nanoporous metal. The characteristic length scale of np-Au can easily be controlled by adjusting the dealloying conditions or annealing of dealloyed samples. Apart from the exciting functional properties, np-Au attracted much attention as it allows to probe nanoscale mechanical behavior using micron scale samples using the existing micromechanical testing procedures such as nanoindentation and micropillar compression. From the measured macroscopic mechanical response of the porous specimen, the microscopic material behavior is estimated using mechanics of cellular solids. Experiments reveal that the strength of its ligaments approaches the theoretical strength of gold as the ligament diameter is reduced. The elastic modulus is also reported to be tunable by controlling the ligament diameter. In this talk I will present an atomistics-informed multiscale modelling approach to model size effects in the elastic behavior of np-Au. Experimentally observed size effects in strength, deformation mechanisms and the proposed theories will be discussed. Using the real structure of np-Au from nanotomography, we will investigate the structure-property relations and evaluate the direct adoption of scaling laws of engineering foams to the nanoporous metals.

*speaker