

**Course:** Electrocatalysis & Electrosynthesis

**Duration:** 24 hours

**Teacher(s):** Abdirisak Ahmed Isse (12 hours)  
Durante Christian (12 hours)

**Curriculum:** Chemical Sciences

**Description:**

Electrochemical kinetics

- a) The inherent kinetics of electron transfer at electrodes, Butler-Volmer equation; limiting cases of low and high overpotentials.
- b) Effects of mass-transfer; Fick's laws of diffusion and their applications in electrochemistry; diffusion overpotential.

Electrochemical techniques

Electrochemical methods in three- and four-electrode cell configurations; cyclic voltammetry: reversible, quasi-reversible and irreversible systems; effect of chemical reactions coupled with electron transfer(s); rotating disk and ring disk electrode; electrochemical impedance spectroscopy; electrochemical probe microscopy.

Homogeneous electrocatalysis

- a) Homogeneous electrocatalysis by metal complexes
- b) Homogeneous electrocatalysis by organic mediators
- c) Some homogeneous electrocatalytic reactions of relevance: electrochemically mediated atom transfer radical polymerization; reductive cleavage of organic halides, etc.

Heterogeneous electrocatalysis

- a) Microscopical view of an electrocatalytic surface
- b) A quantitative descriptor for catalysis: the Volcano plot.
- c) Examples of important electrocatalytic processes: hydrogen evolution reaction; water splitting; O<sub>2</sub> reduction reaction, CO<sub>2</sub> reduction, activation of carbon-halogen bonds, etc.