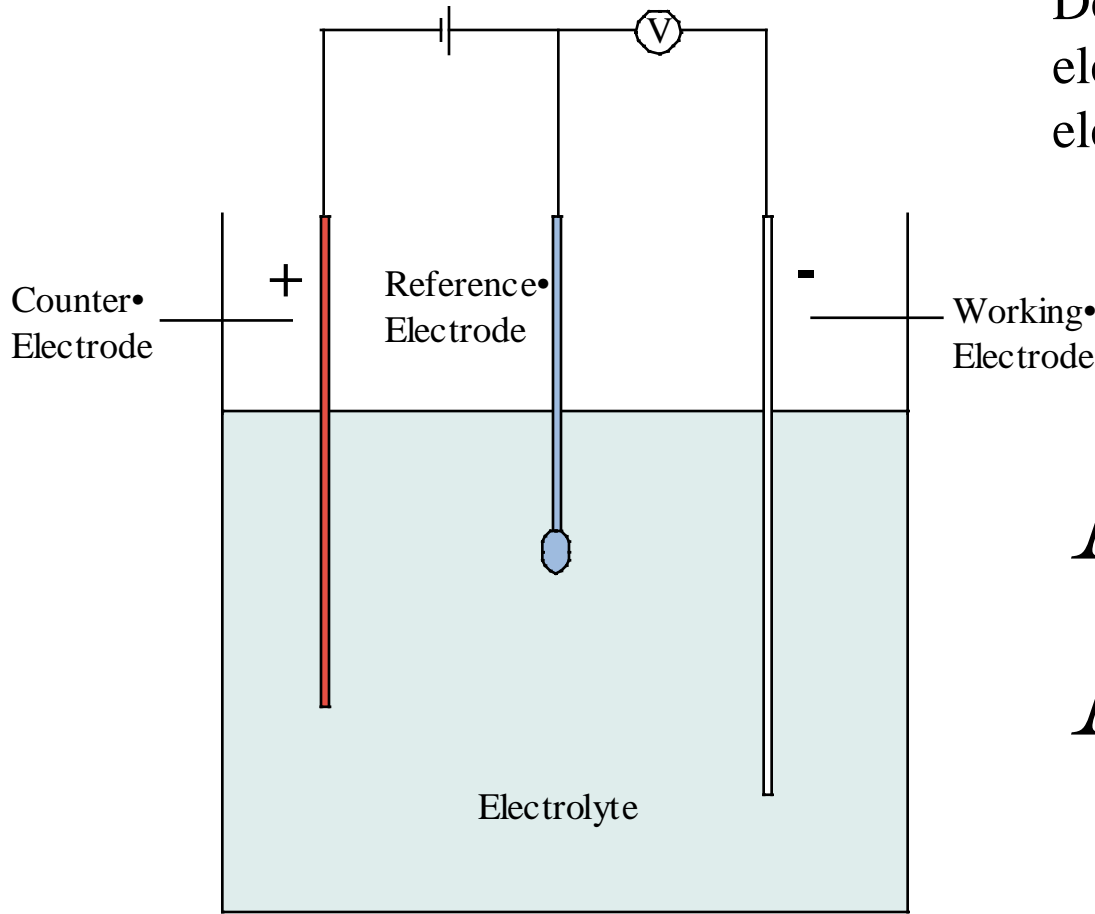


Chemical Synthesis Techniques

Thin Films & Variations

Electrochemical Deposition

(Electrodeposition, Electroplating)



Deposition of materials from an electrolyte by the passage of an electrical current.

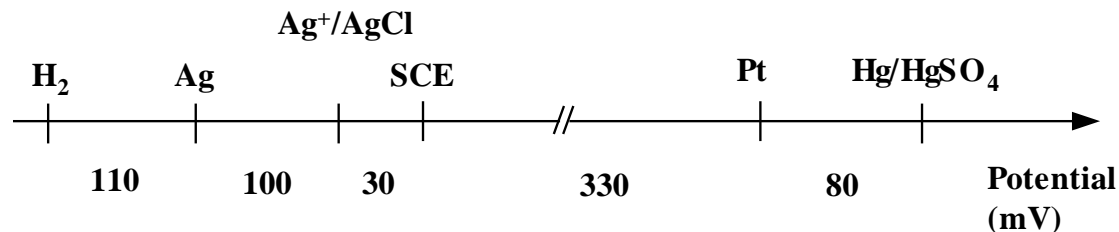


Electrodes

Counter electrode: conducting & stable
e.g., Pt

Working electrode: conducting & stable
also substrate for deposition

Reference electrode: compatible w/ electrolyte



Deposition Process

Immersing metal electrode into a solution



Equilibrium potential of the metal - ion pair: Nernst equation

$$E_{eq} = E_o + (RT/nF) \ln(a/a_m),$$

$R=8.314$ J/K mole, F is the Faraday constant (96,500 C/mole),

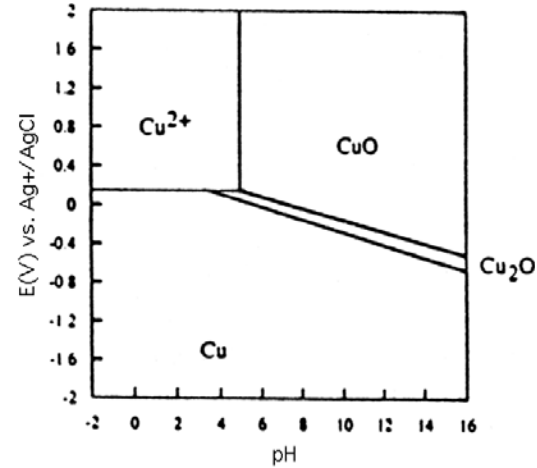
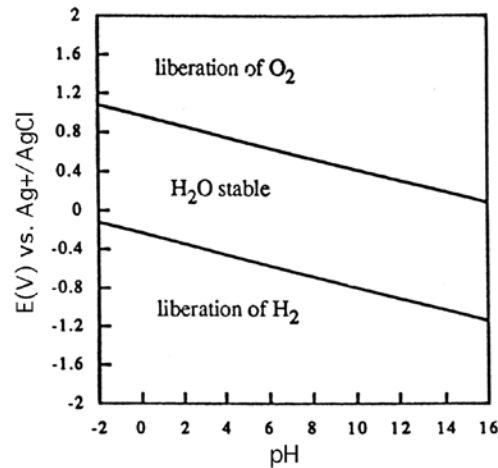
n is the valence, a and a_m are the activities of the ion and metal

Over-potential $\eta = E_{appl} - E_{eq}$

For metal ion reduction to metal: need negative over-potential

Variables

Potential-pH phase diagram: Pourbaix diagram



Current efficiency CE

$$CE = W_a / W_{Faraday} \times 100\%$$

Monitoring charge transfer to control growth

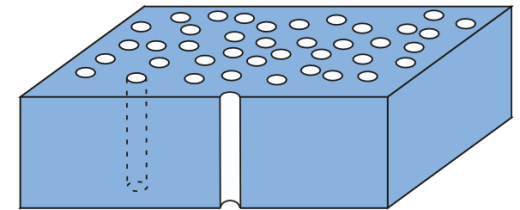
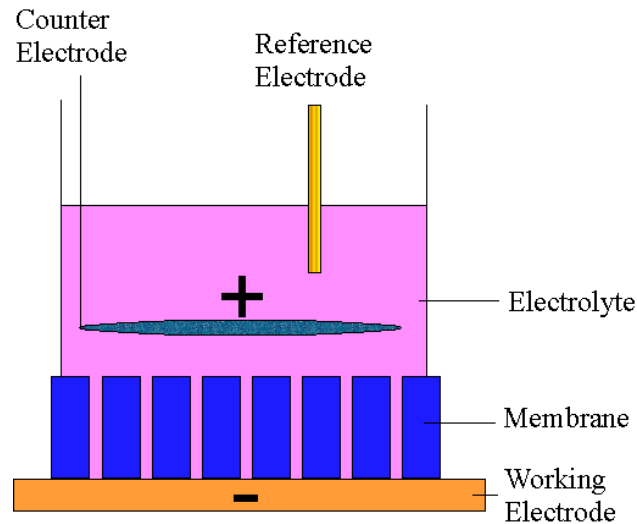
Types of Electrodeposition

Single bath

DC

Pulse

Dual bath

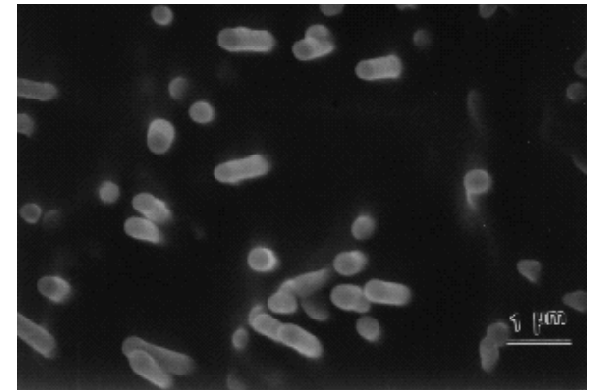


Advantages:

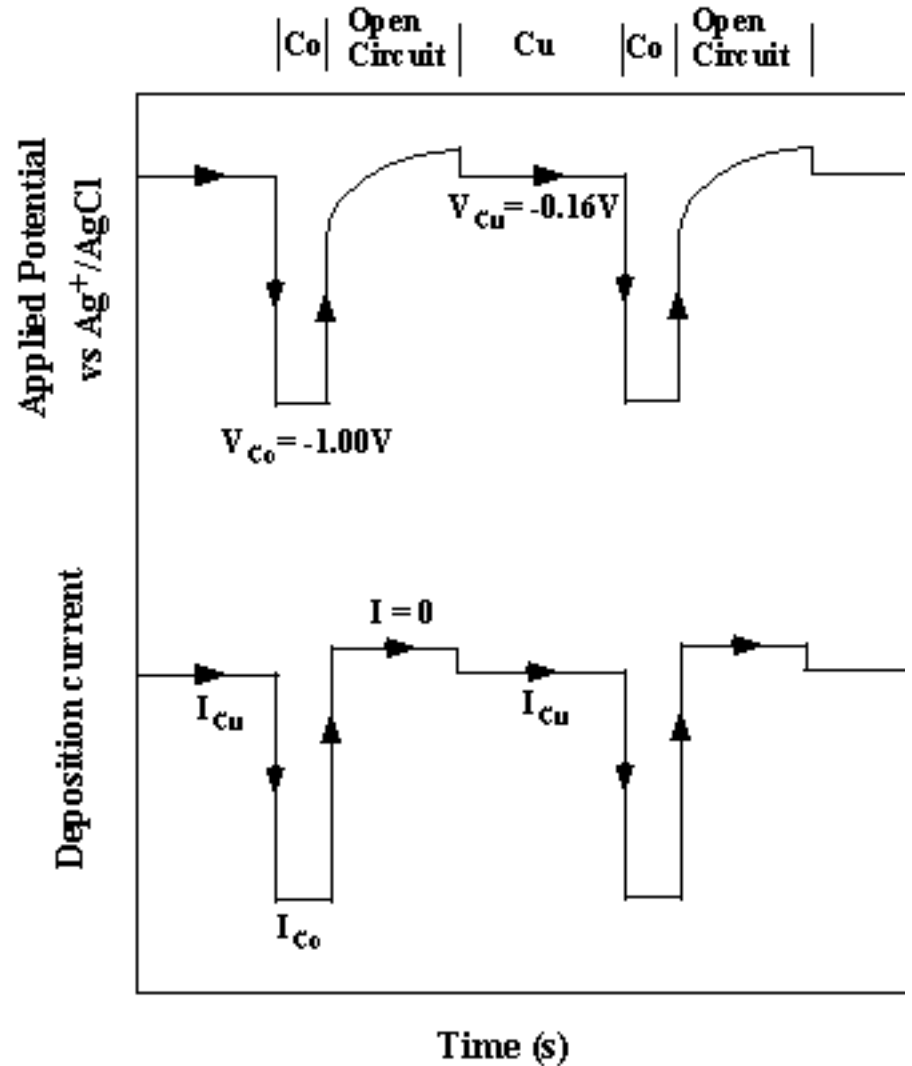
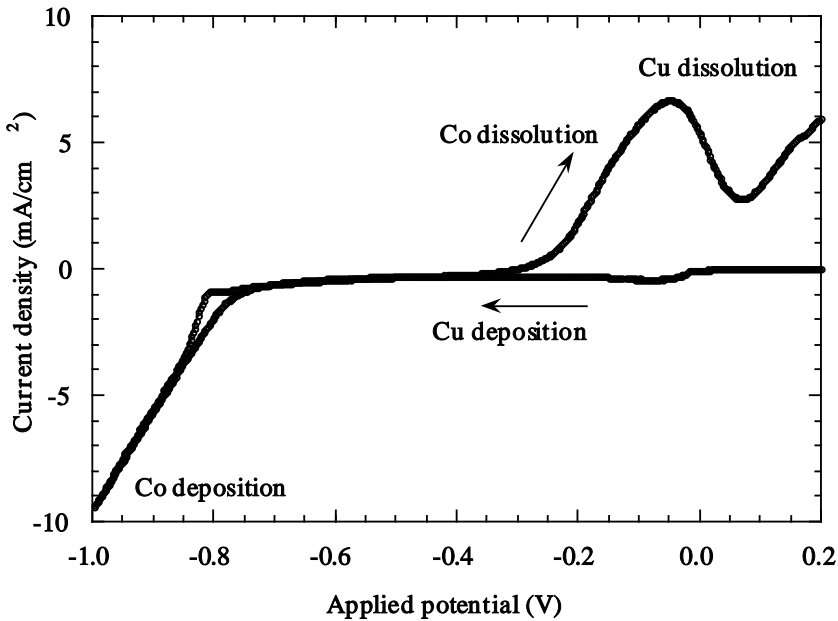
Ambient T & P

Cost effective

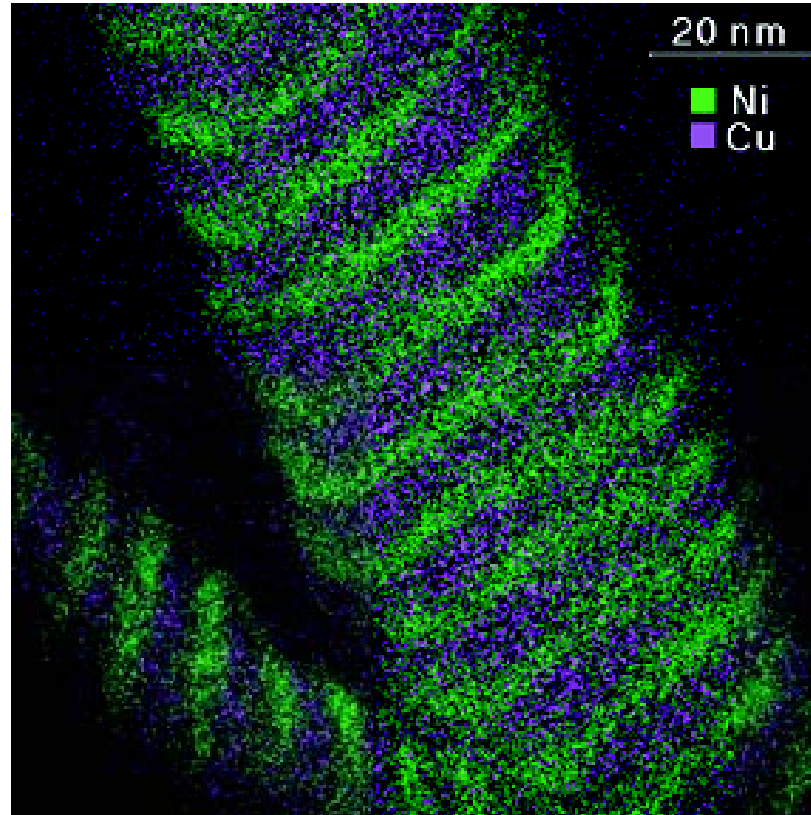
Deposition onto complex structures



Multilayer Deposition



Multilayered Nanowires



CVD

