

# **Electrochemical Cells**

**Electrochemical cell    Galvanic cell**

**Voltaic cell**

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**Voltaic cell**

**a device in which electricity is produced by a spontaneous redox reaction**

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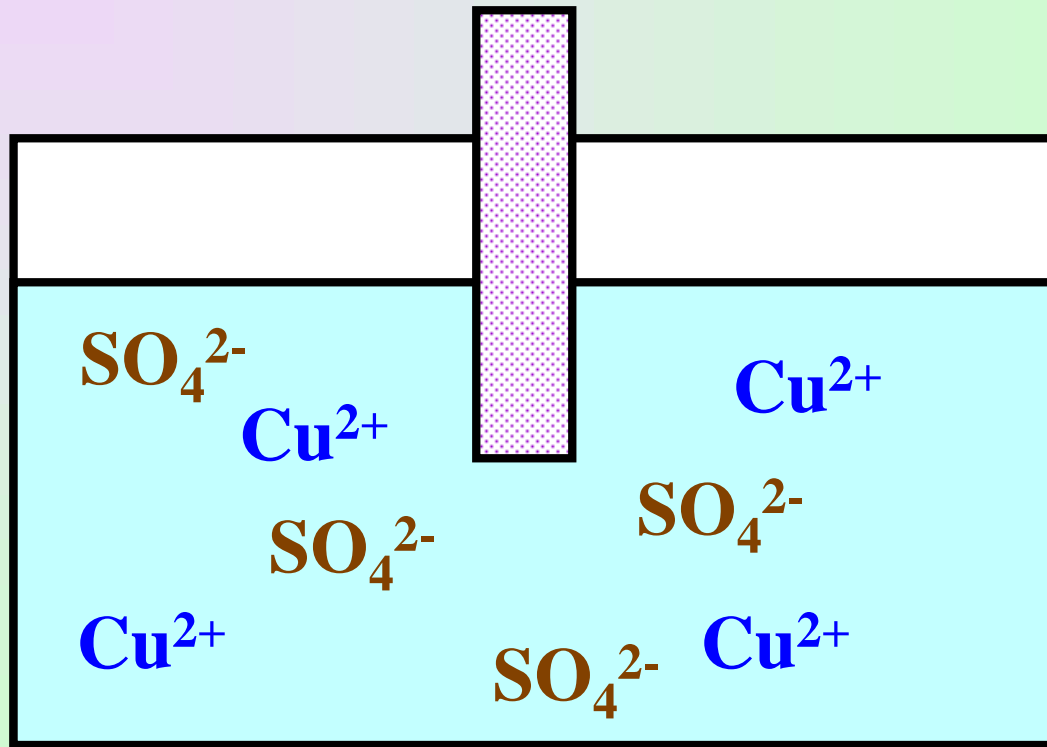
**by separating the oxidizing agent from the reducing agent electrons are transferred via an external conducting medium**

# Construct a galvanic cell based on the oxidation-reduction reaction

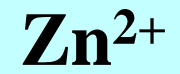
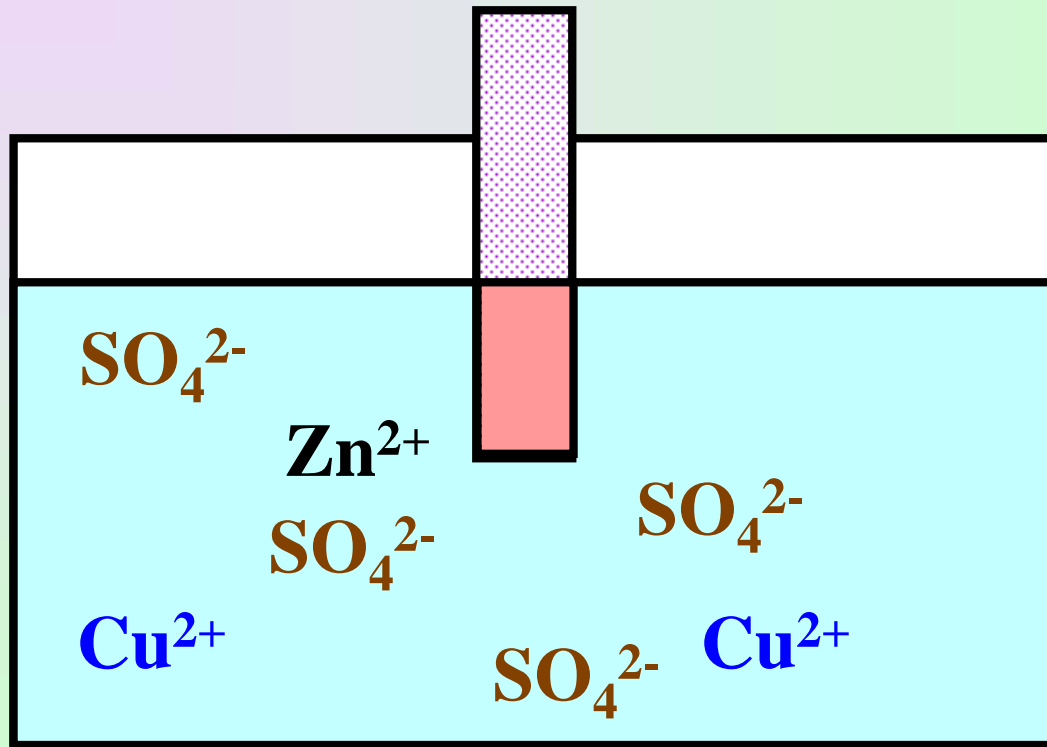


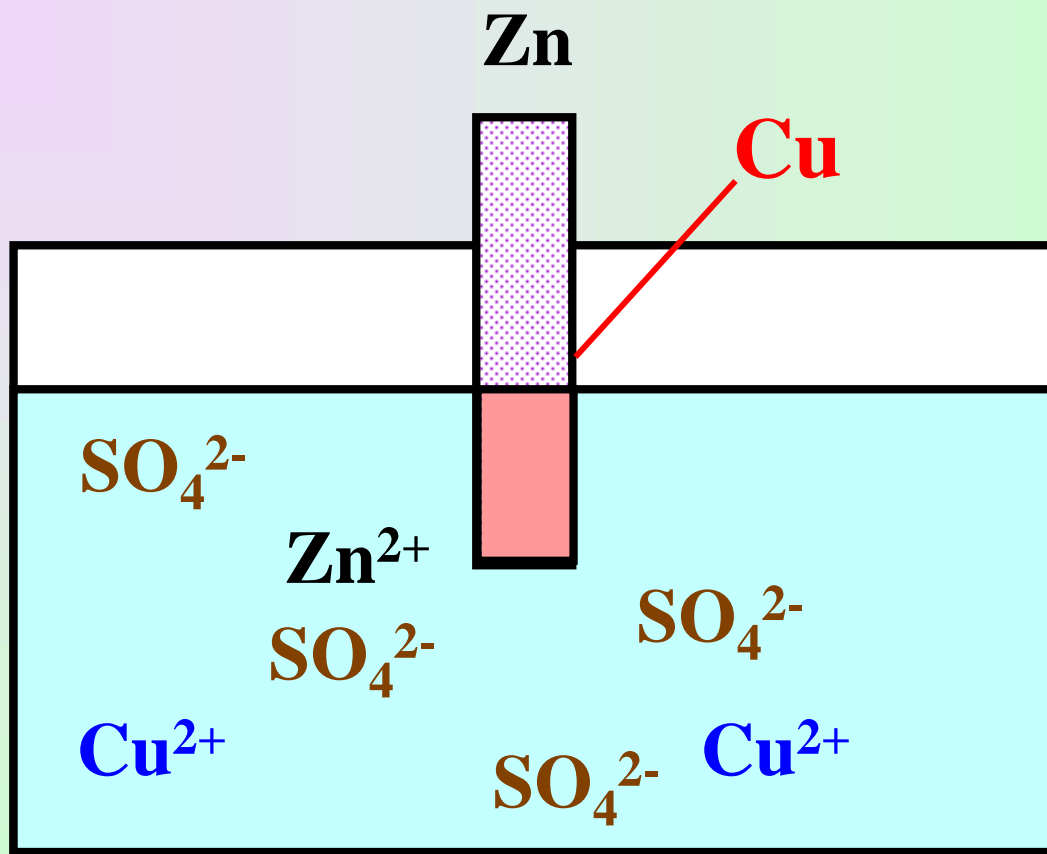
goal is to generate an electrical current

Zn

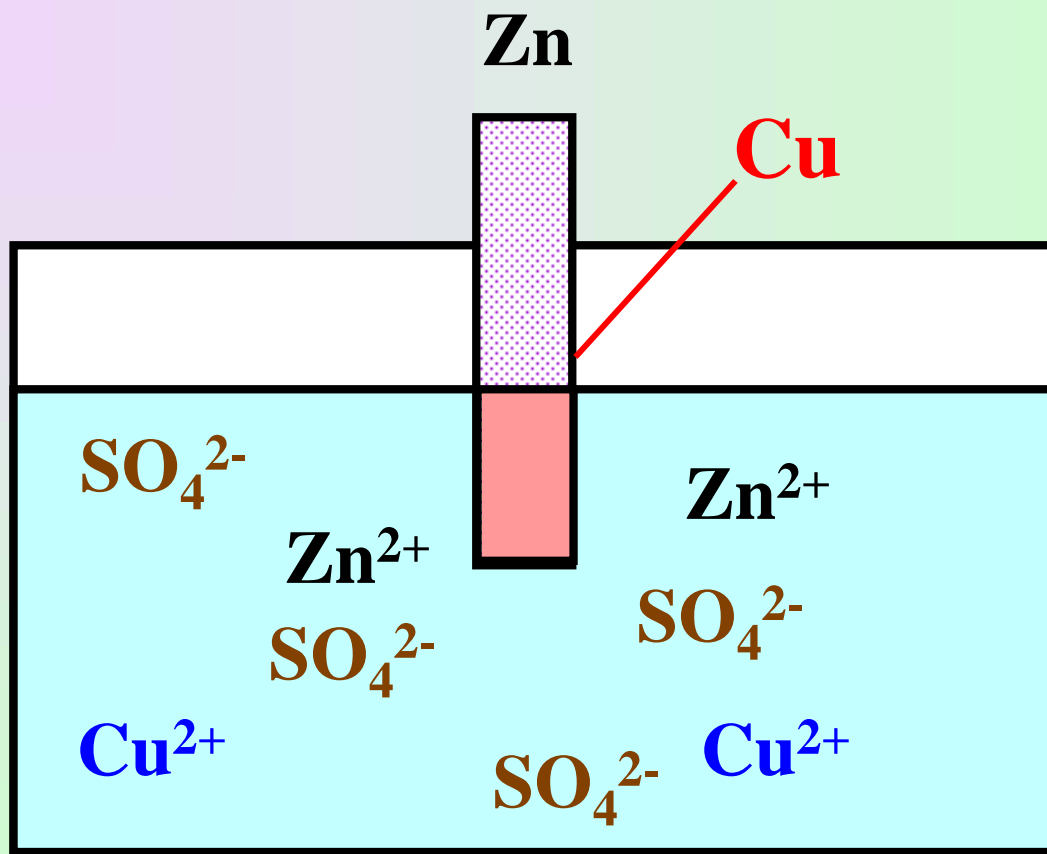


Zn

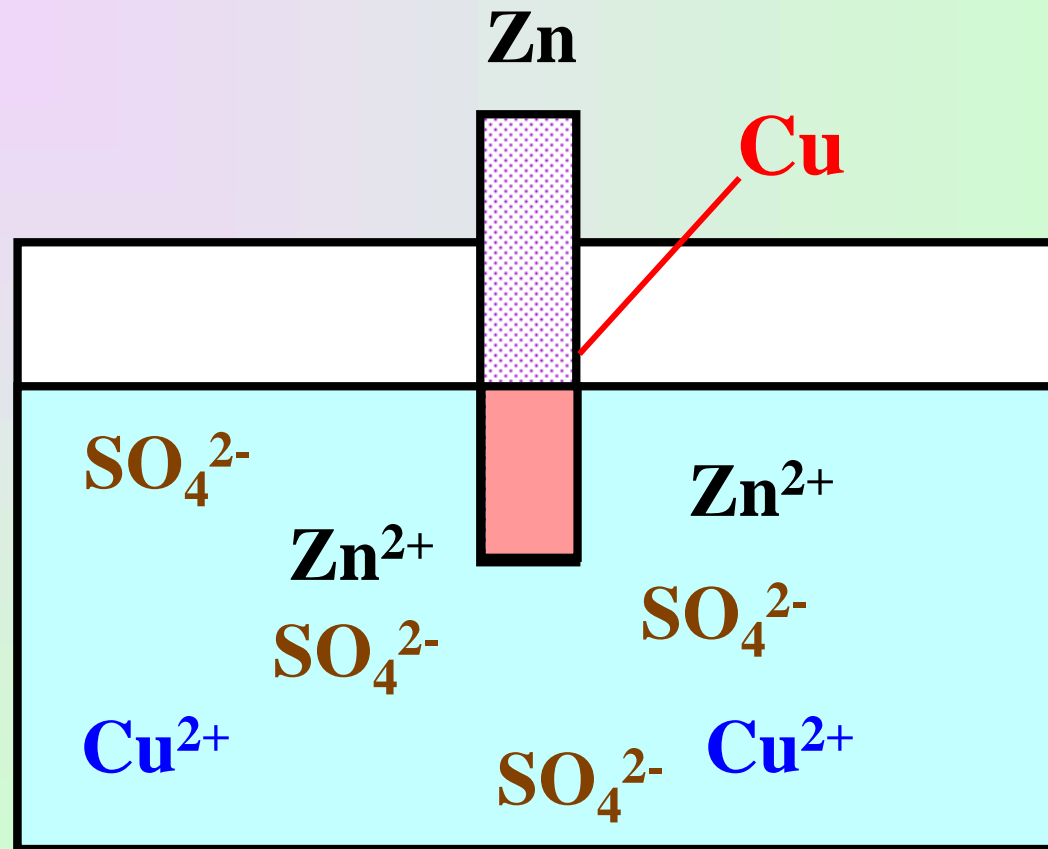




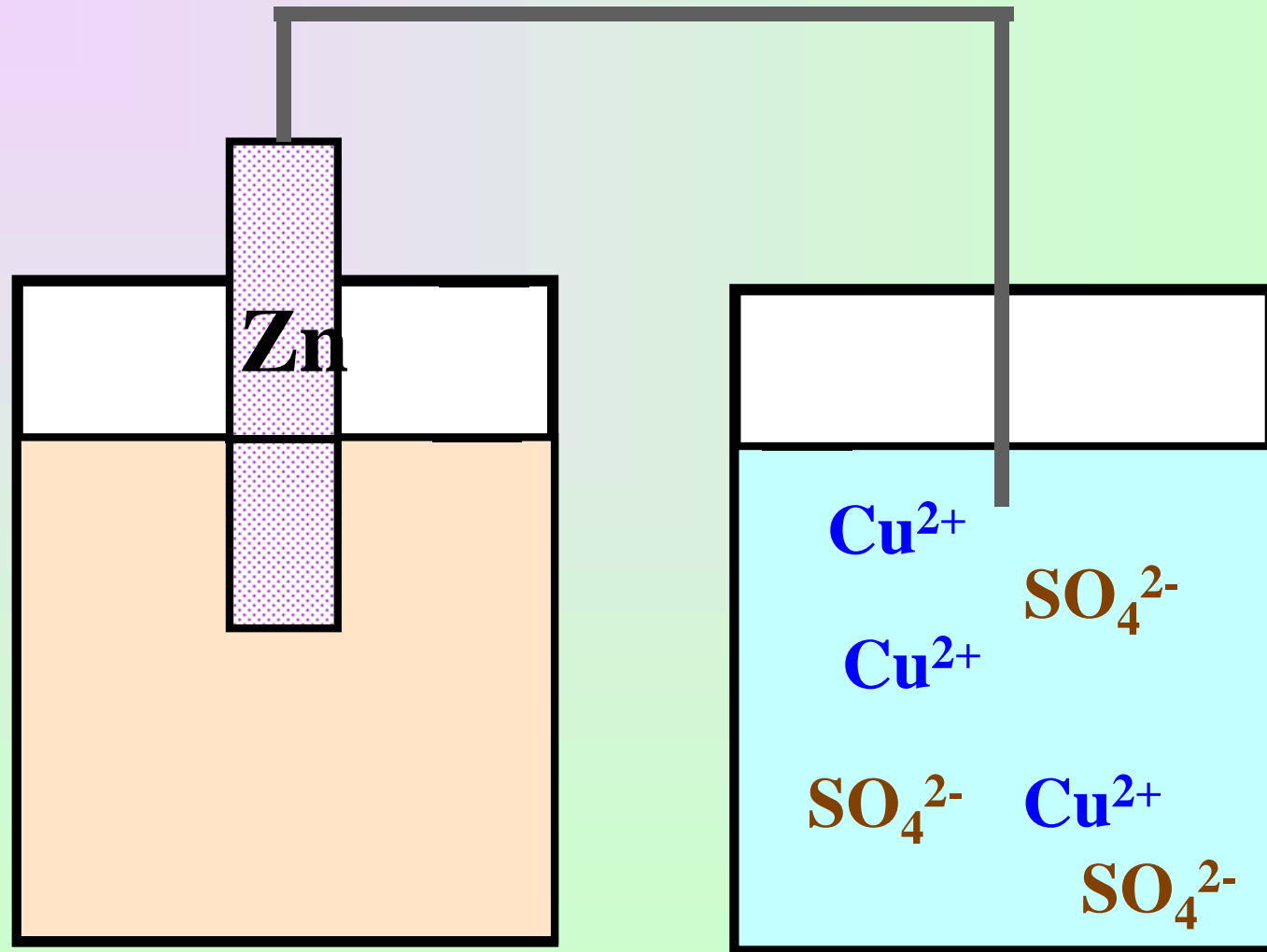




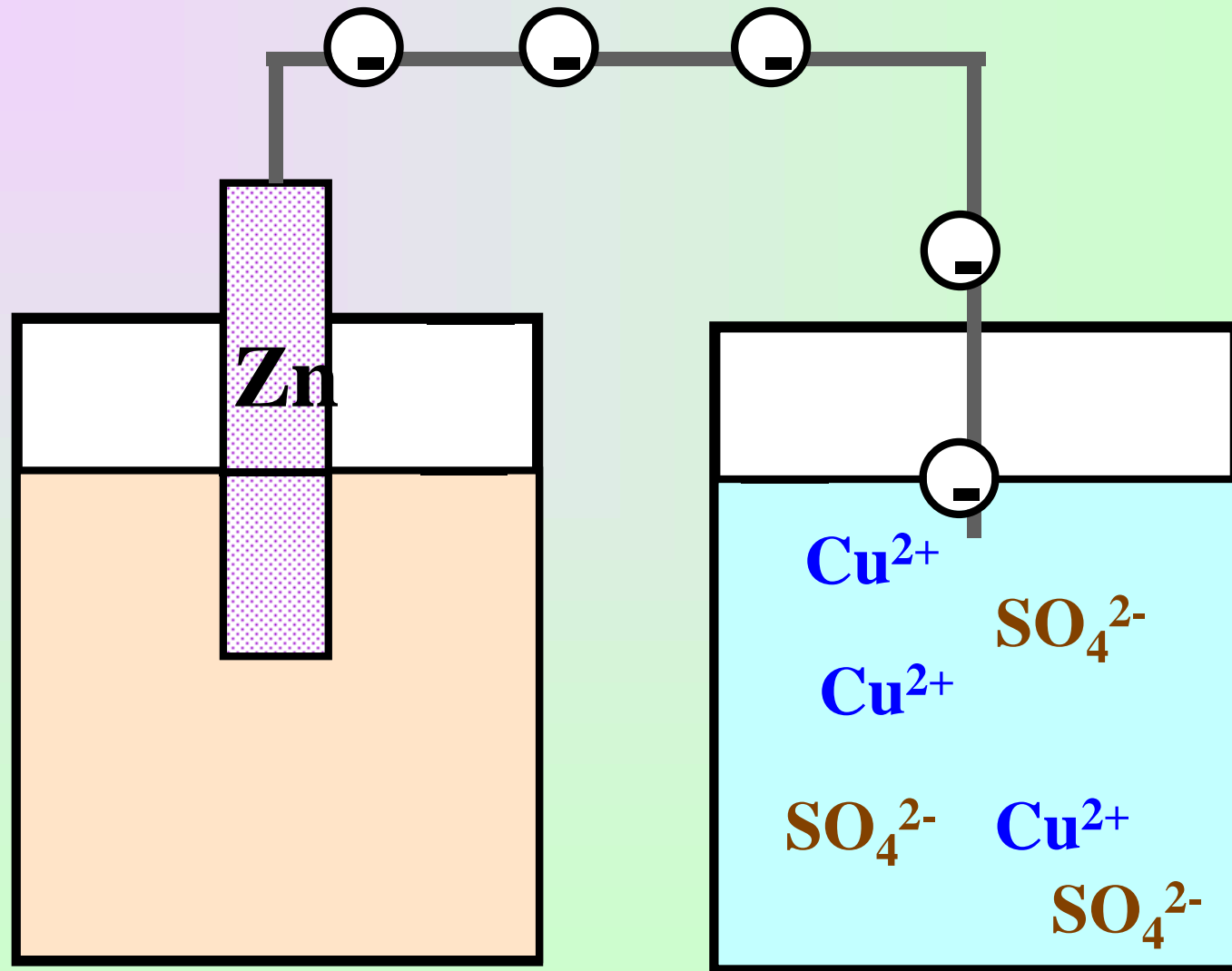
**electrons flow but no useful current is generated**



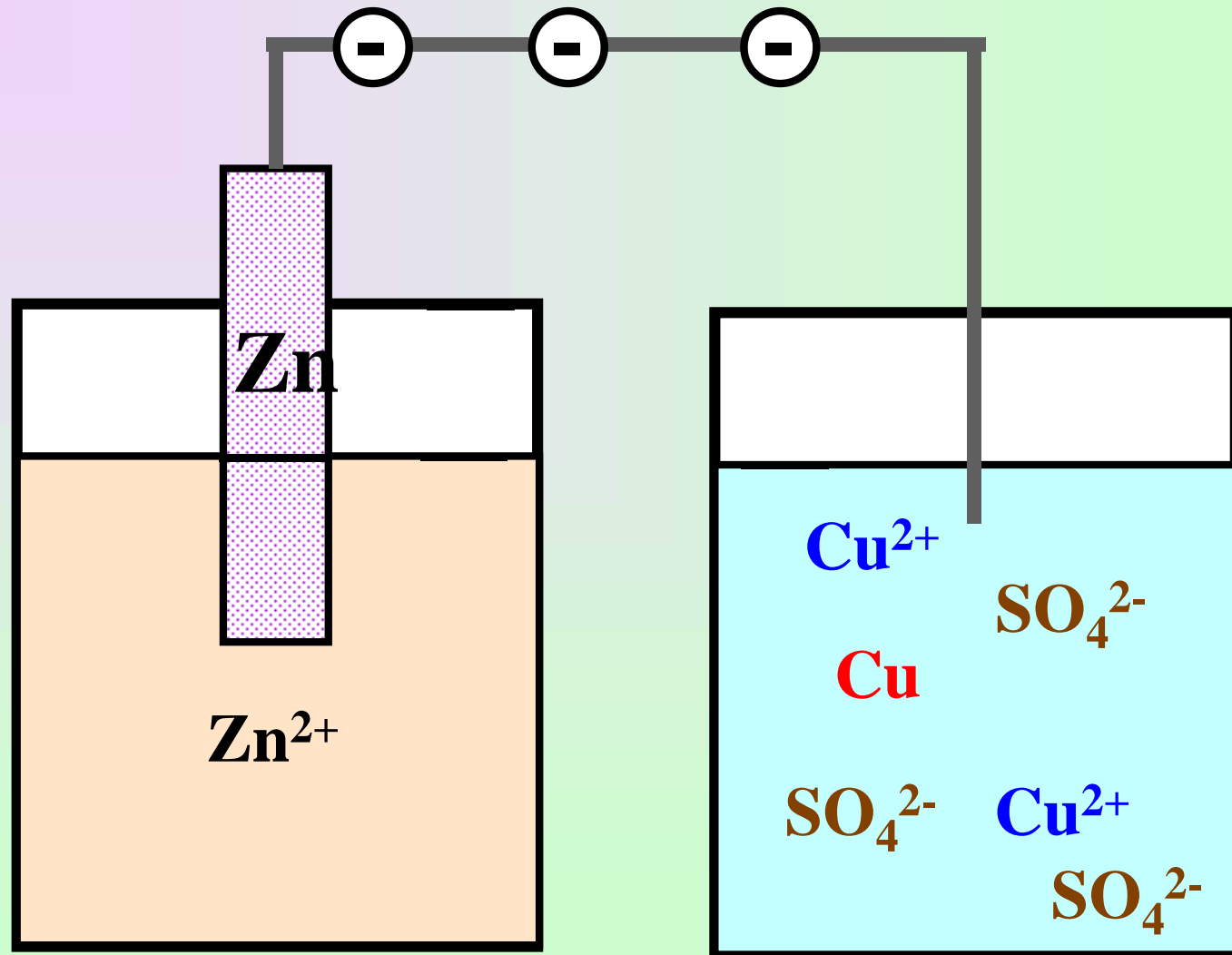
Consider the same two species in separate vessels



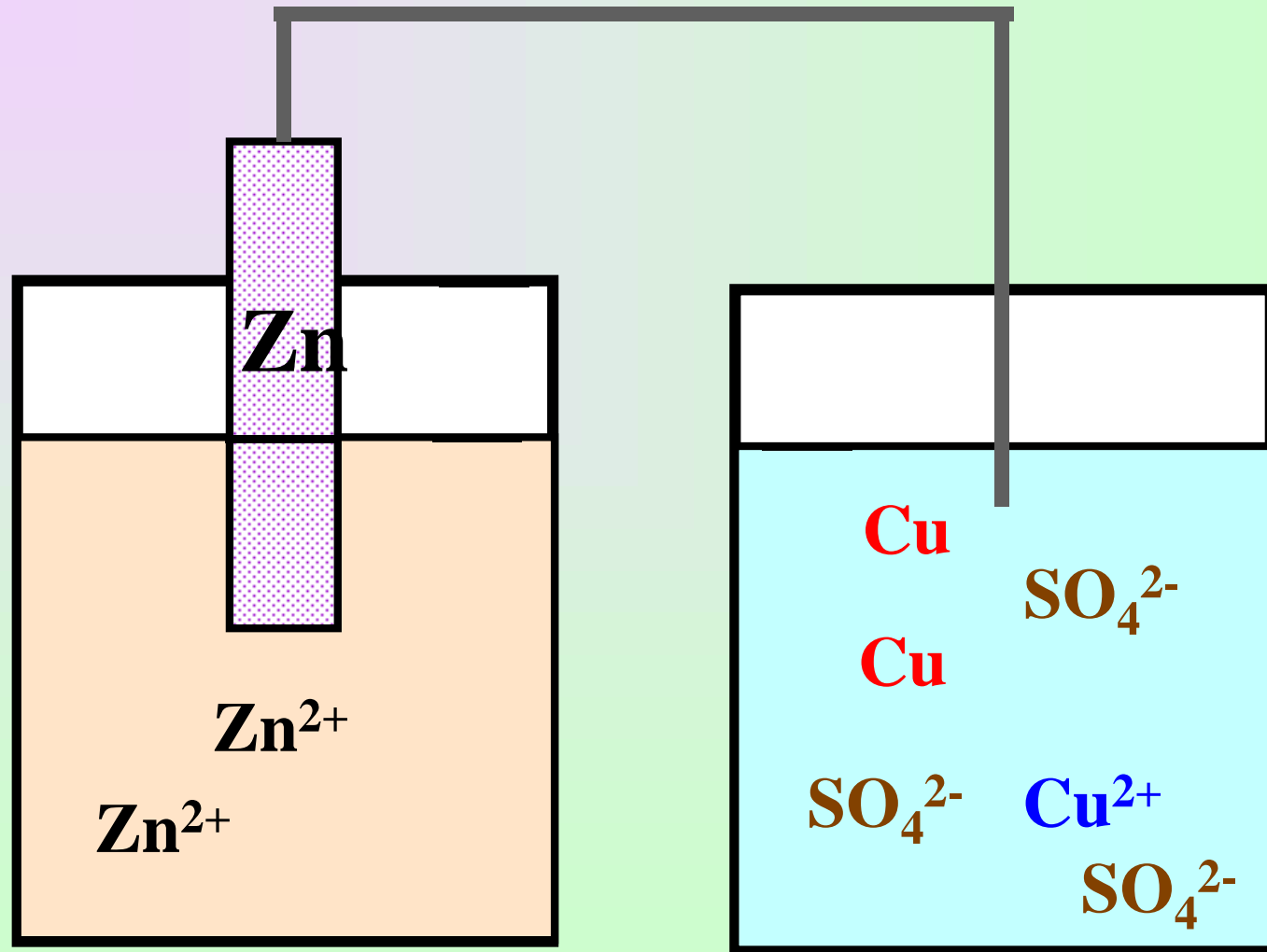
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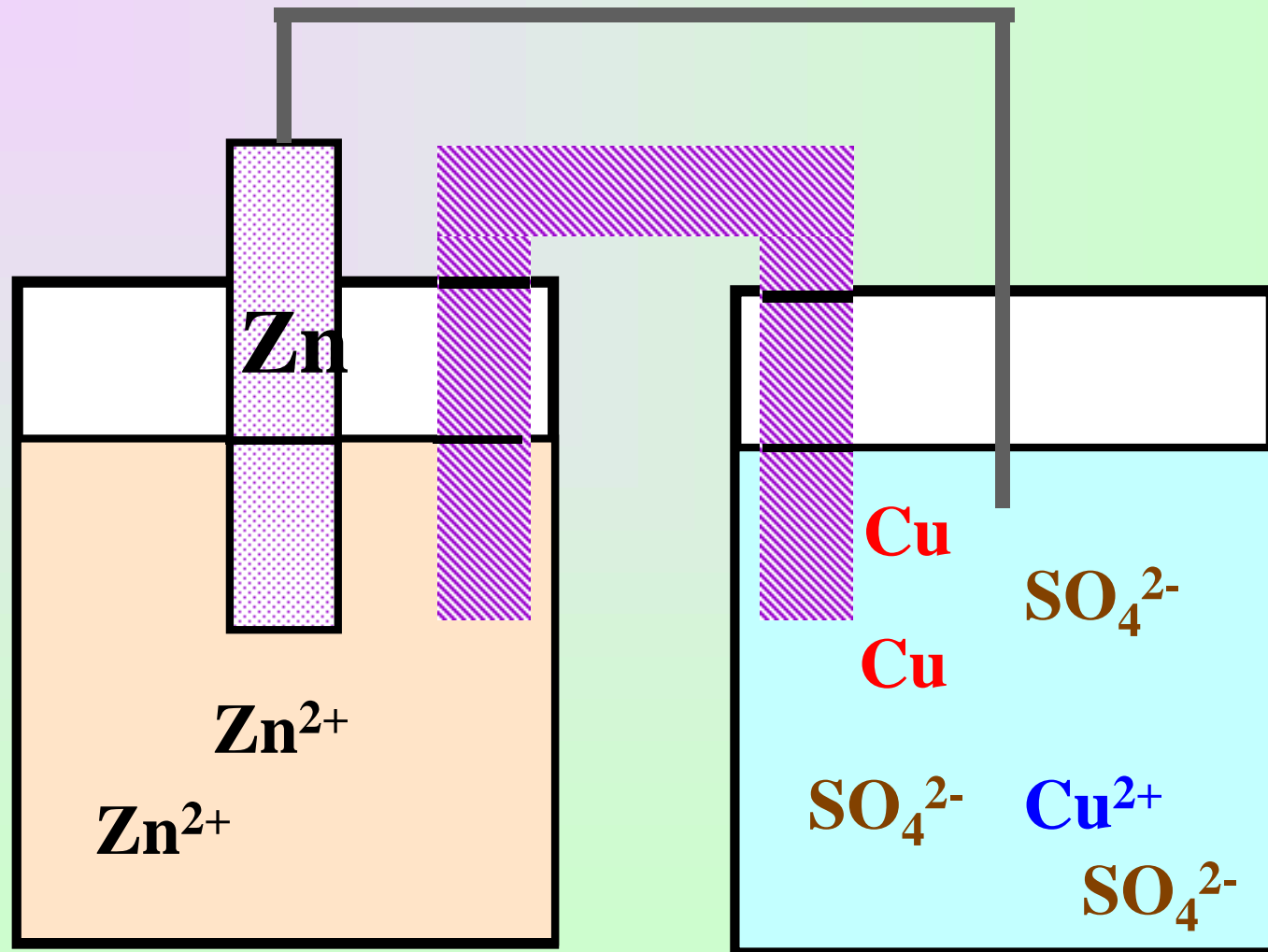
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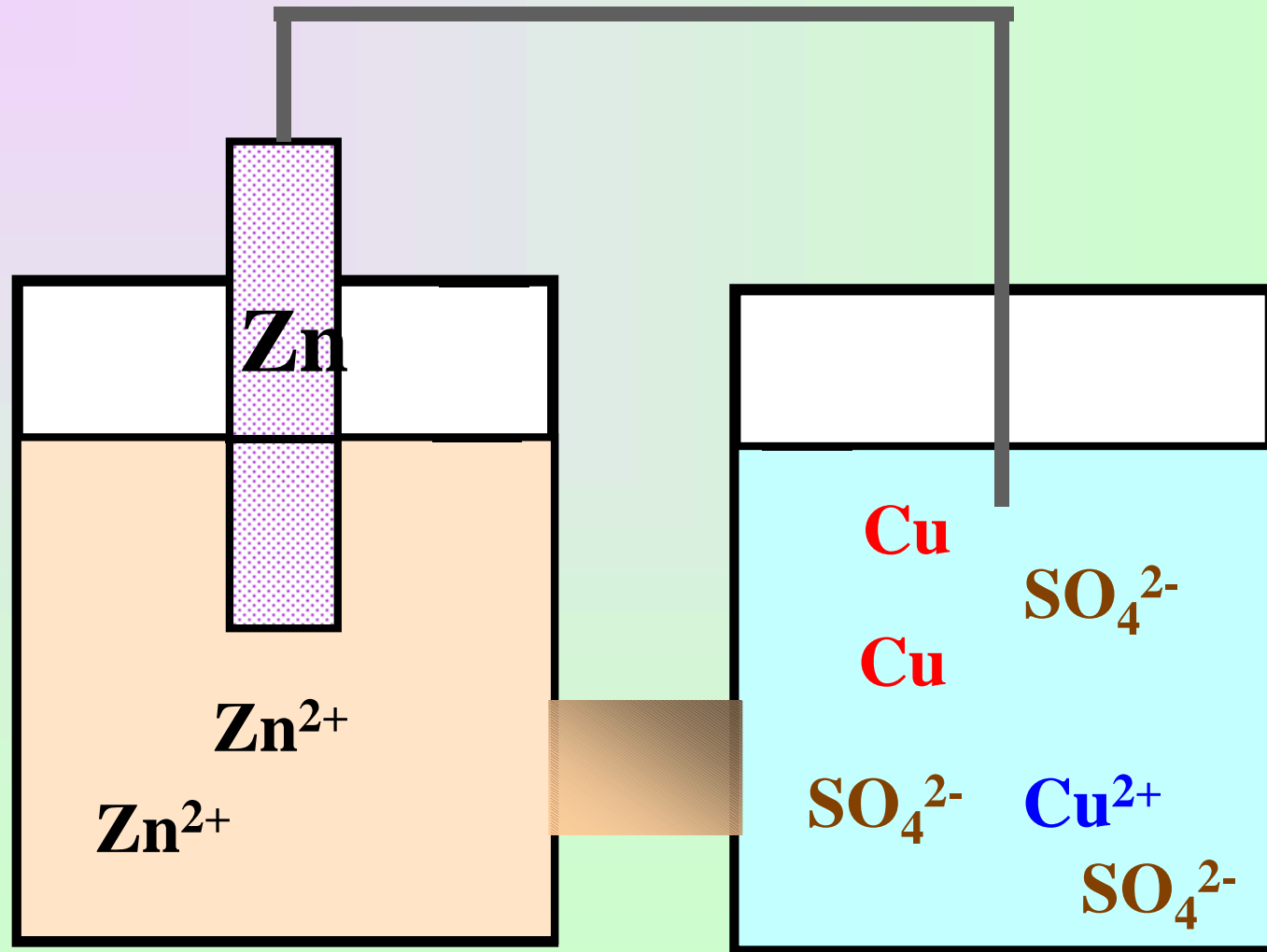
Consider the same two species in separate vessels  
electrons soon stop flowing



Connect the vessels by a salt bridge

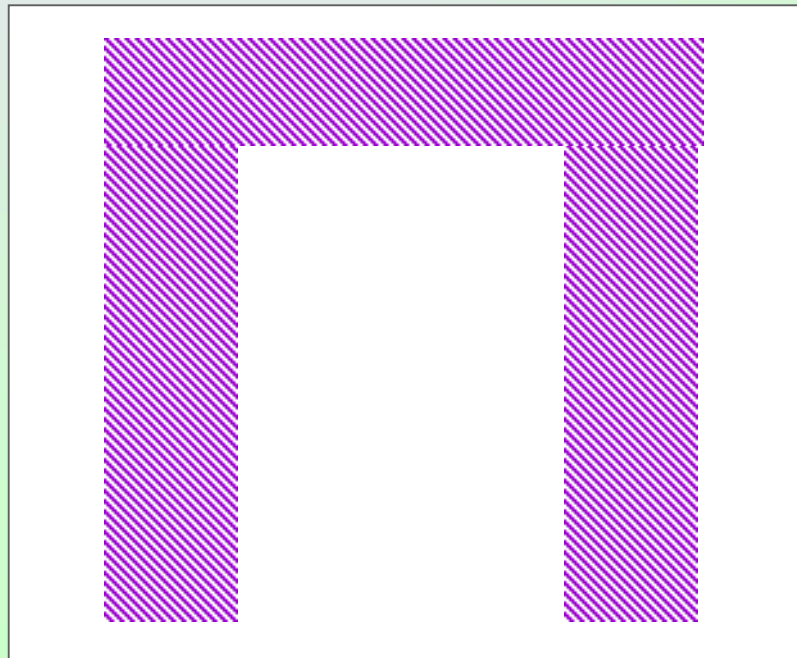


or a porous disk



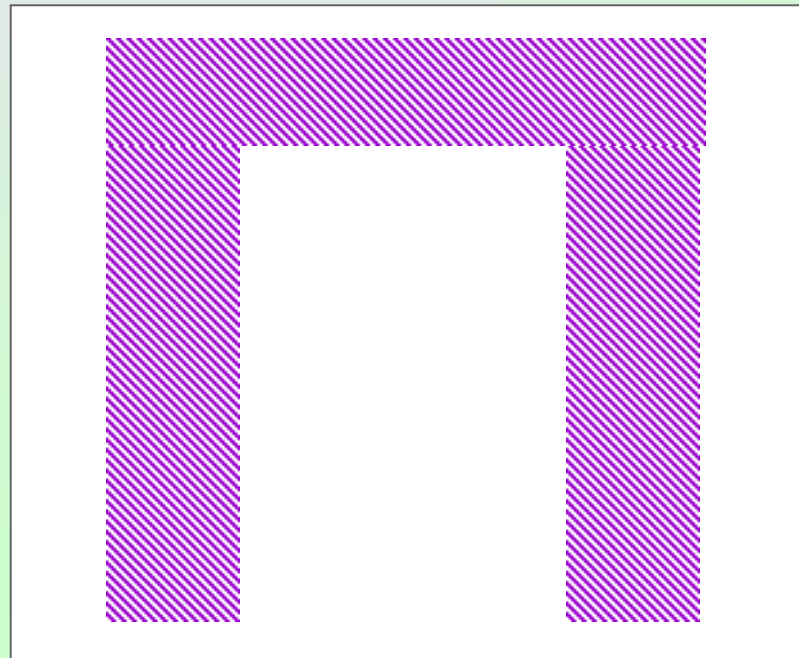


**a salt bridge**



# a salt bridge

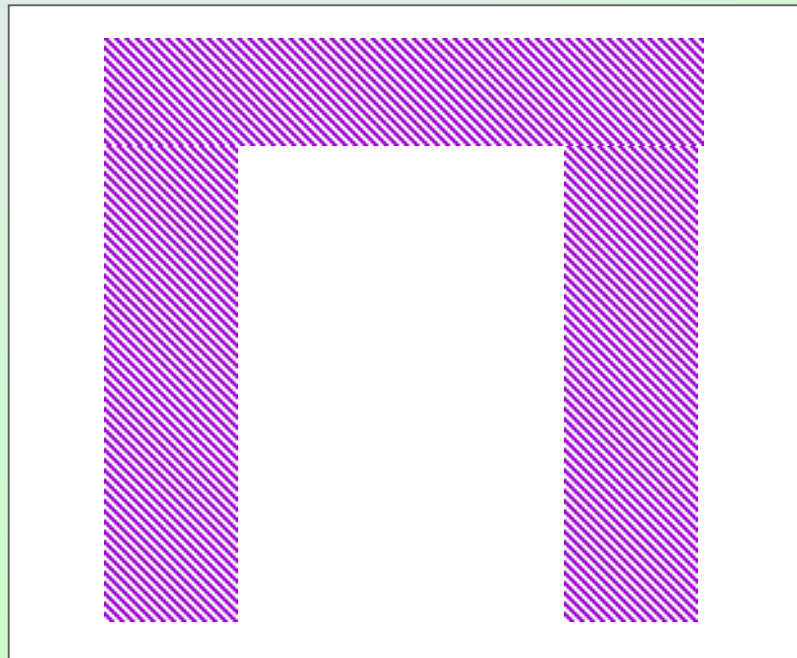
**completes the electric circuit**



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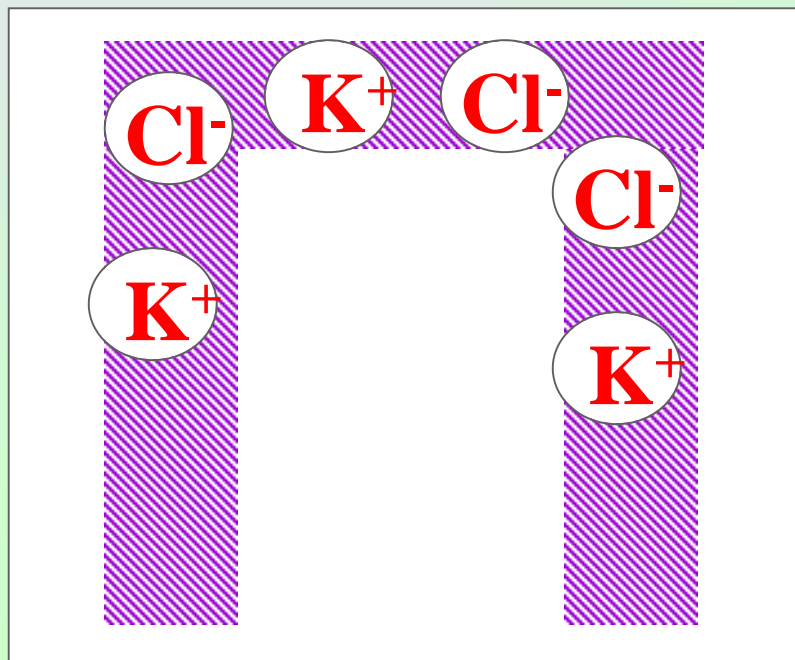
**composed of an inert electrolyte (KCl,  $\text{NH}_4\text{NO}_3$ ) whose ions will not react with the other ions or electrodes in the cell**



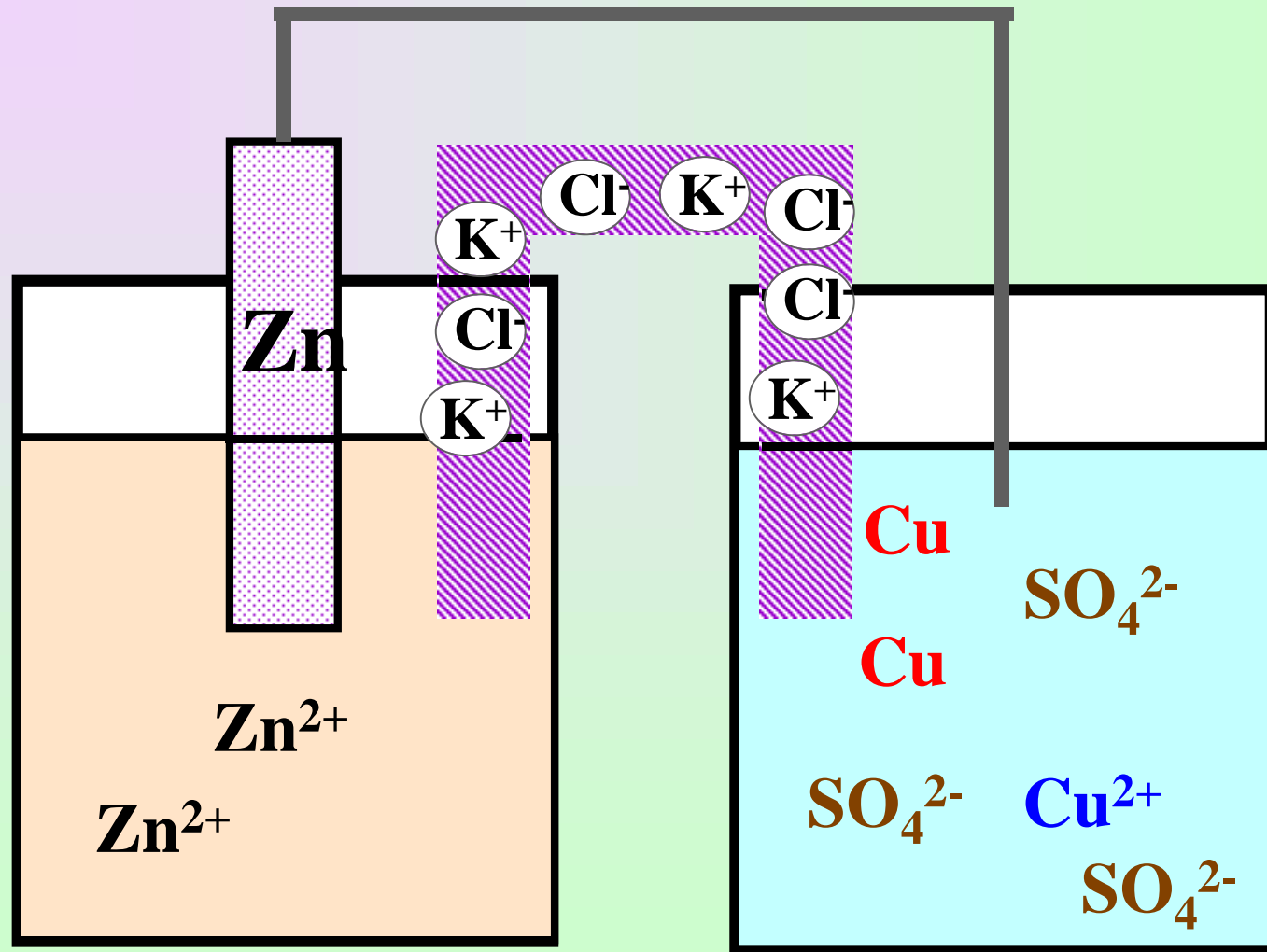
## a salt bridge

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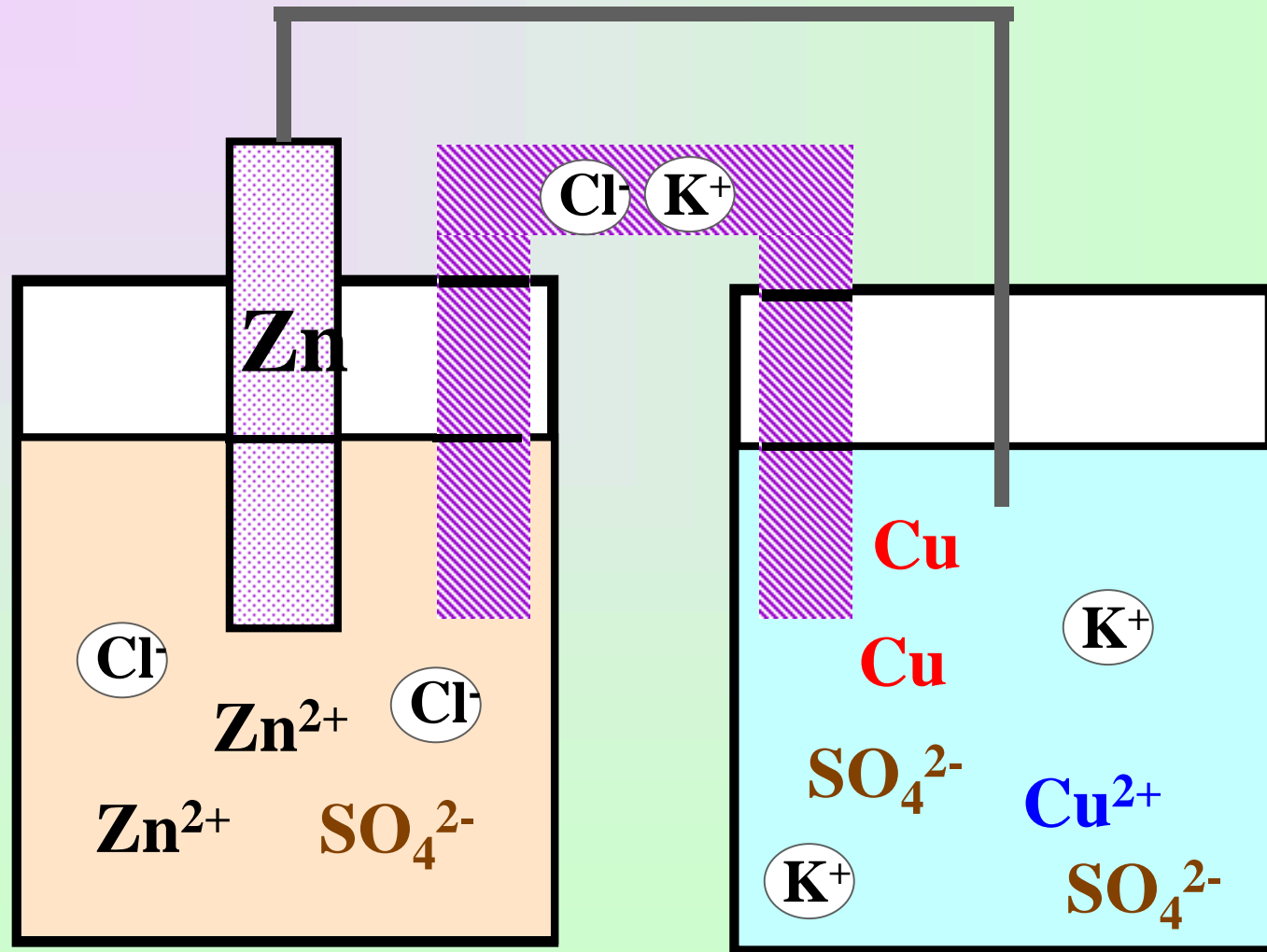
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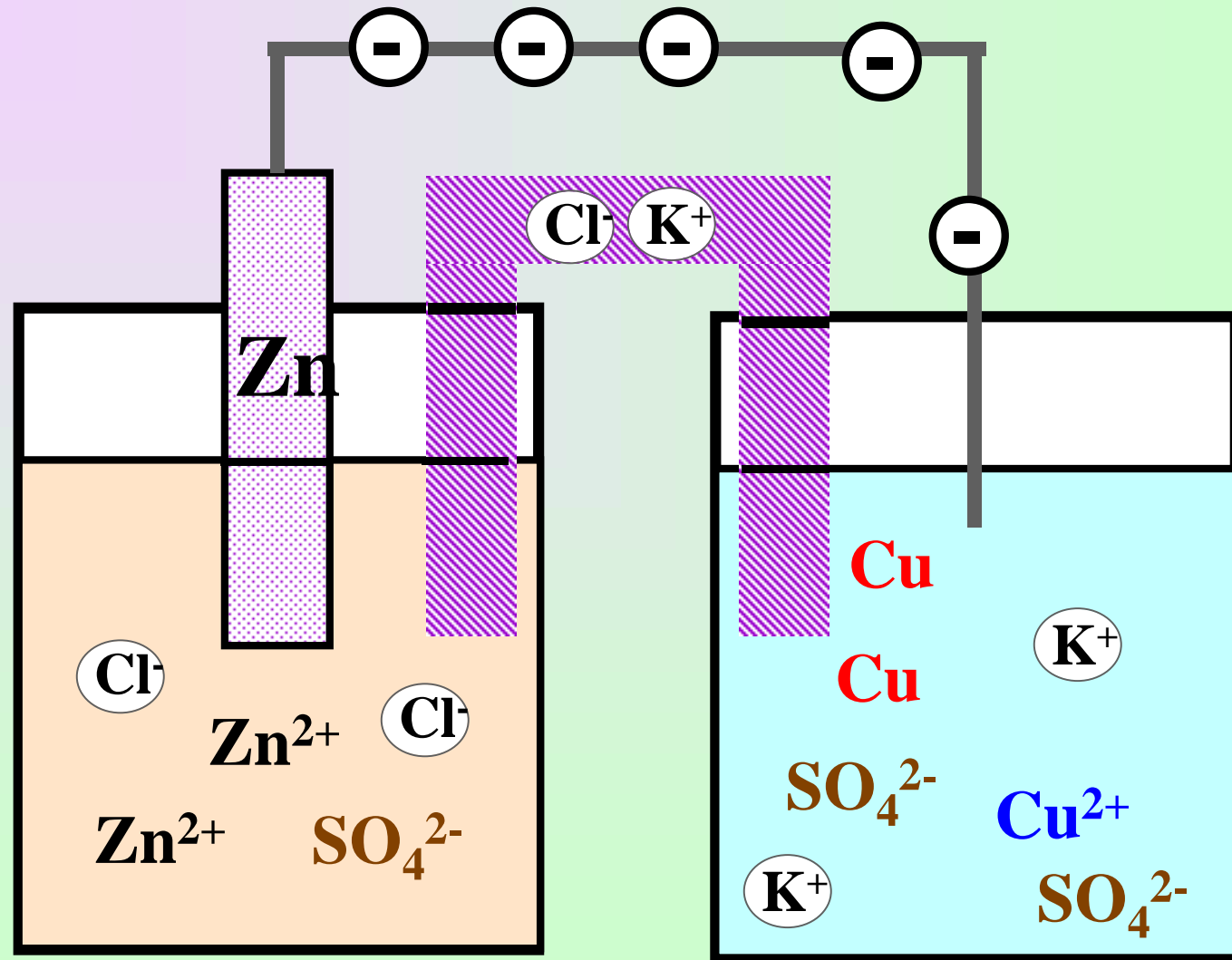
# a salt bridge



# Ion flow balances charges



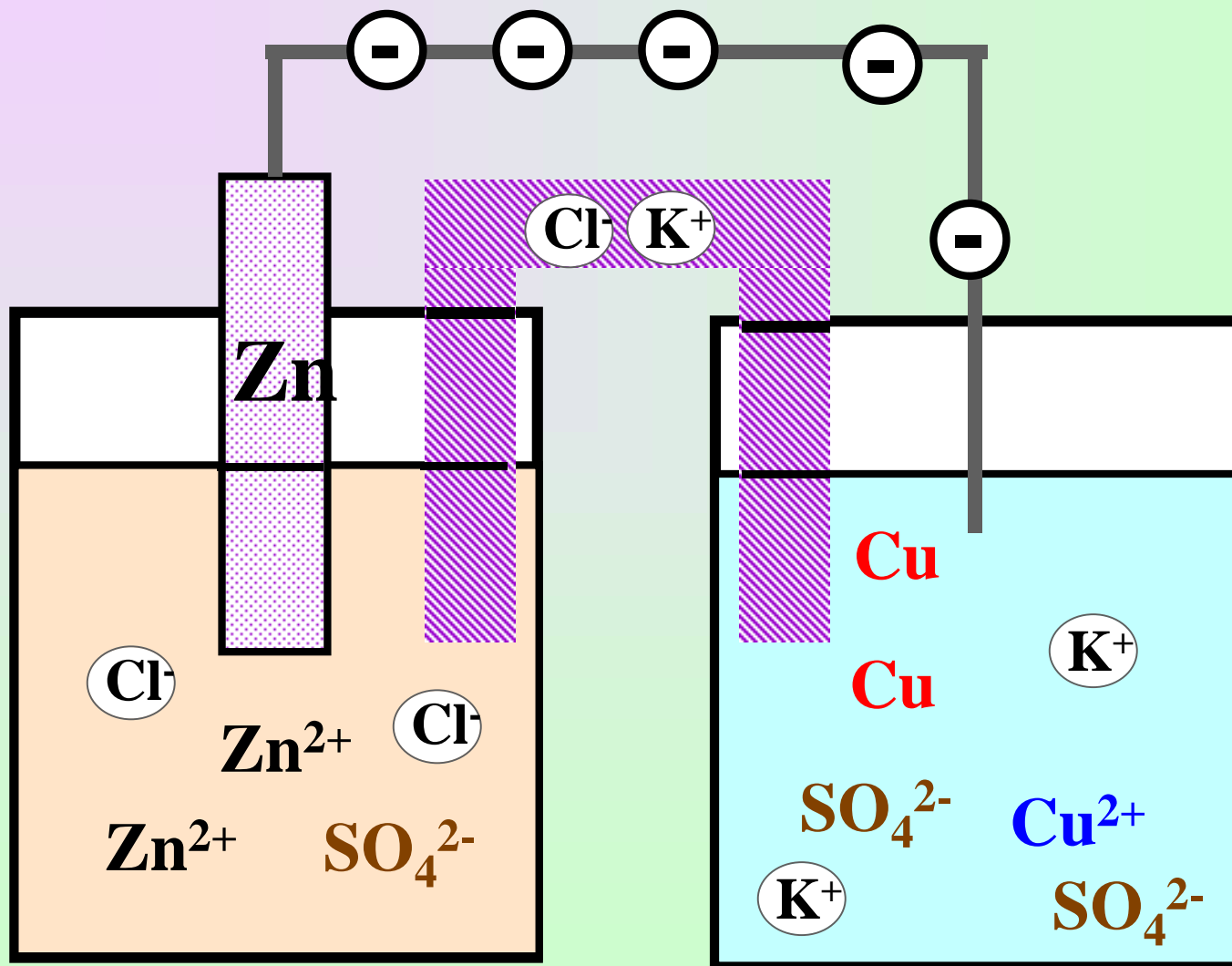
# Ion flow balances charges and permits electron flow



# Galvanic cell

**Anode**

**Cathode**



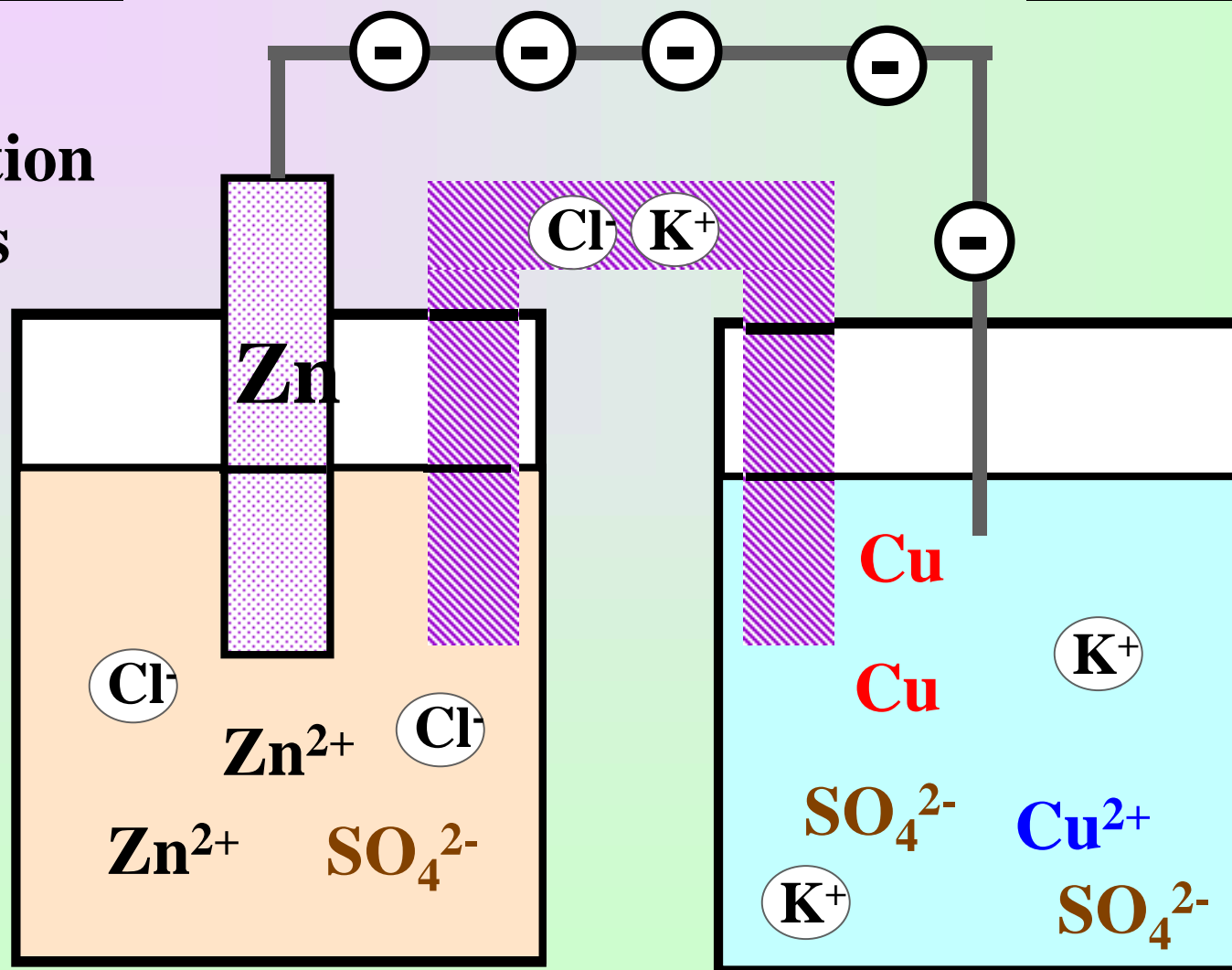


# Galvanic cell

**Anode**

**Cathode**

where  
oxidation  
occurs



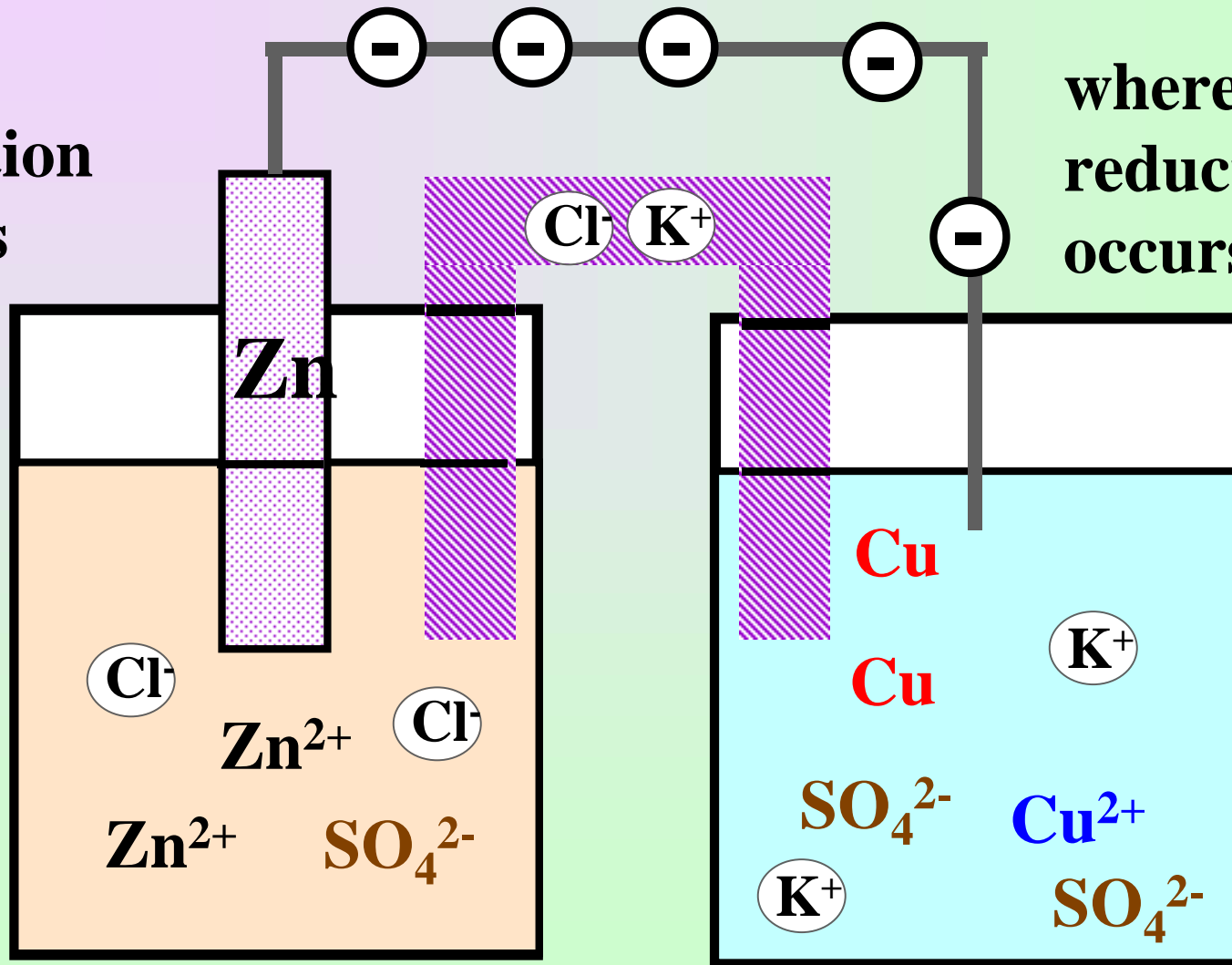
# Galvanic cell

**Anode**

where  
oxidation  
occurs

**Cathode**

where  
reduction  
occurs



# Cell diagram



# Cell diagram

Anode



# Cell diagram

**Anode**

**Cathode**



# Cell diagram

Anode

Cathode



salt bridge

phase boundary

phase boundary

# Cell diagram

Anode

Cathode



salt bridge

phase boundary

phase boundary

*By convention the anode is written first, the other components appear as you would encounter them moving to the cathode.*

# *Cell potential*

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**also called electromotive force (emf)**



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**results from difference in energy of an electron at the two electrodes**

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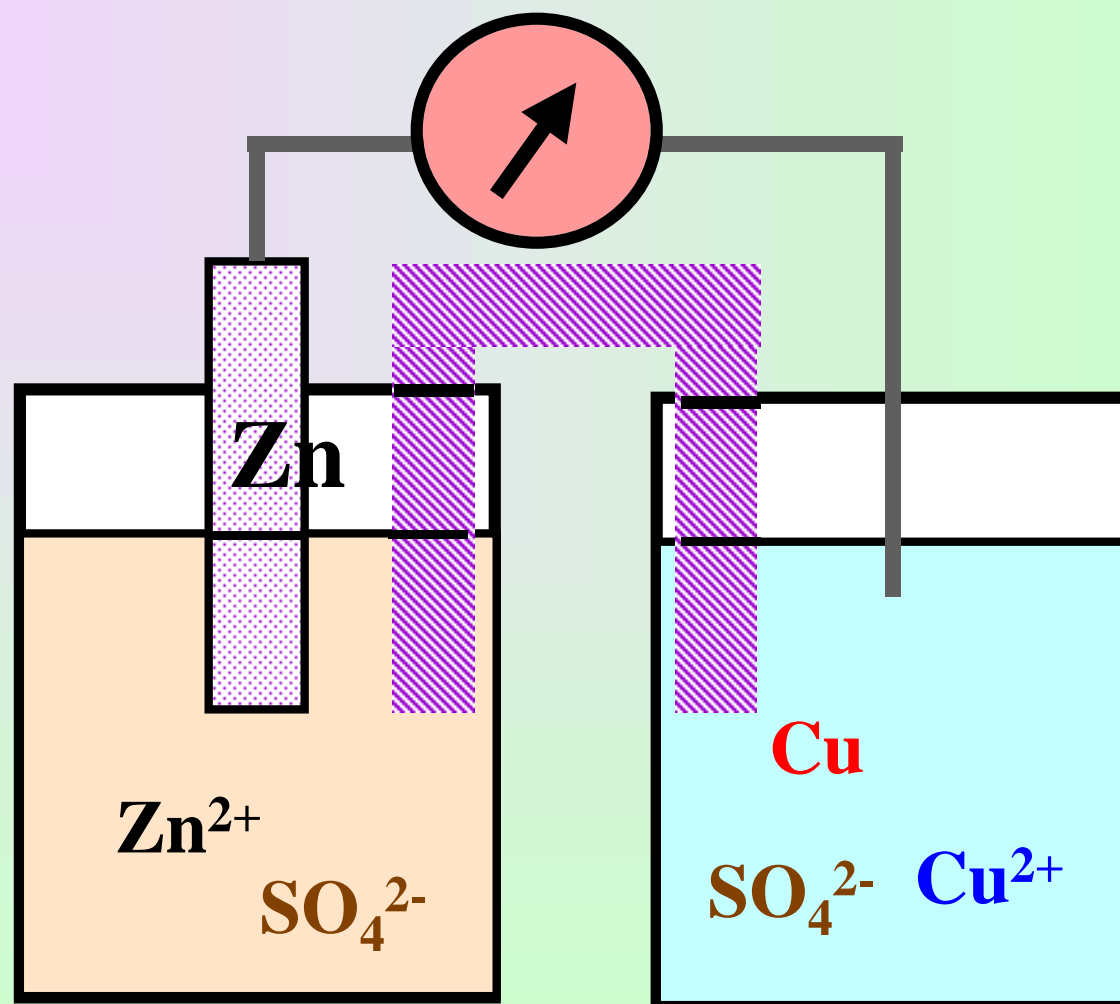
**symbol is script E ( $\mathcal{E}_{\text{cell}}$ )**

**unit is volt (V)**

**1 V = 1 joule/coulomb**

**Cell potential = 1.10 V**

Recall  
the  
galvanic  
cell



**when all species are in their standard state**