

Electrochemical Cells

Electrochemical cell Galvanic cell

Voltaic cell

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

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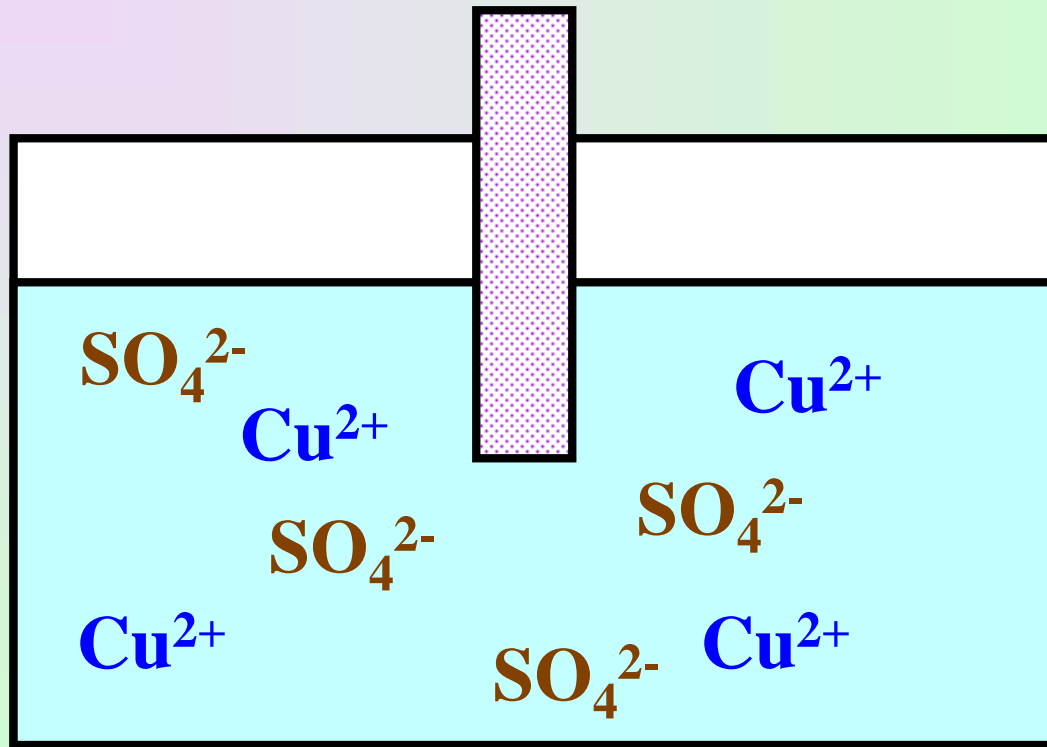
by separating the oxidizing agent from the reducing agent electrons are transferred via an external conducting medium

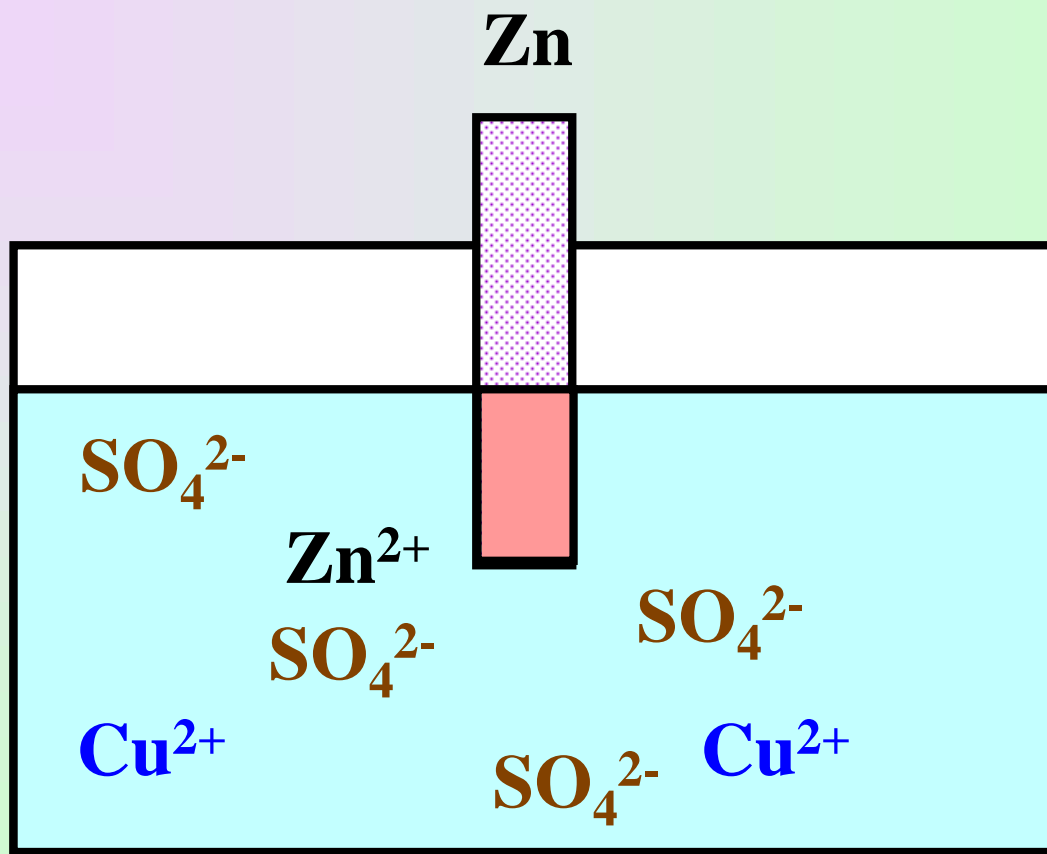
Construct a galvanic cell based on the oxidation-reduction reaction

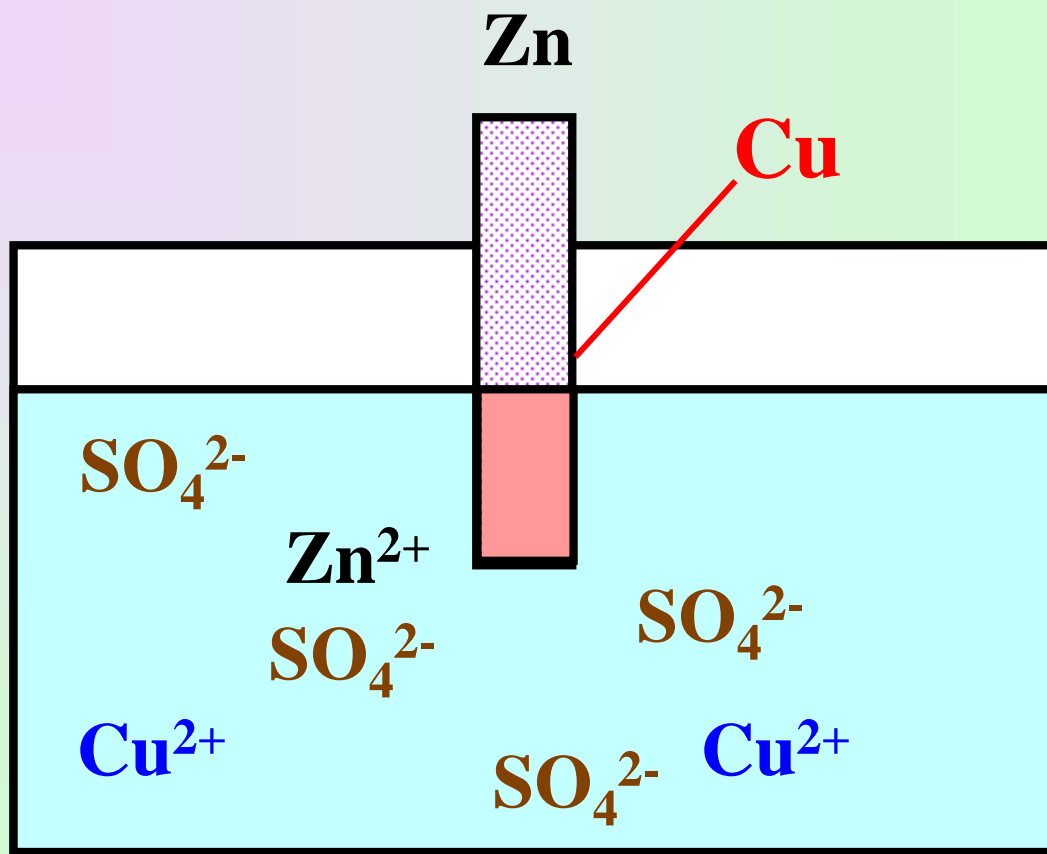


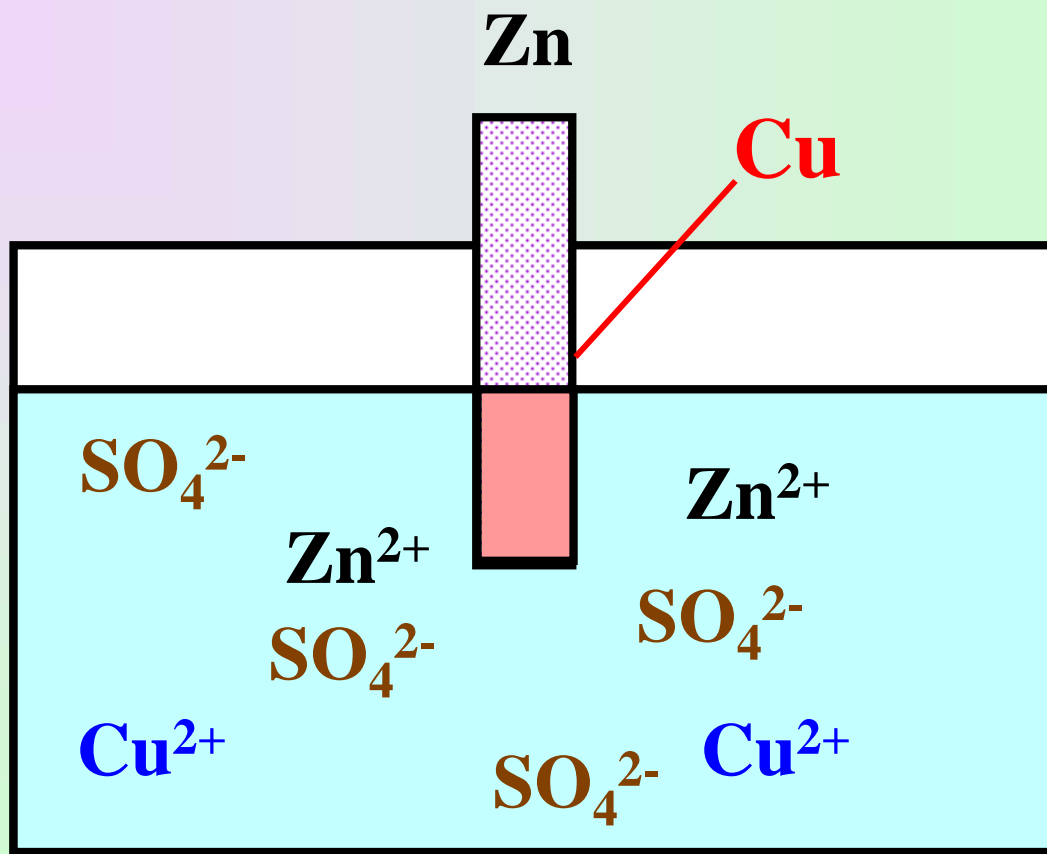
goal is to generate an electrical current

Zn

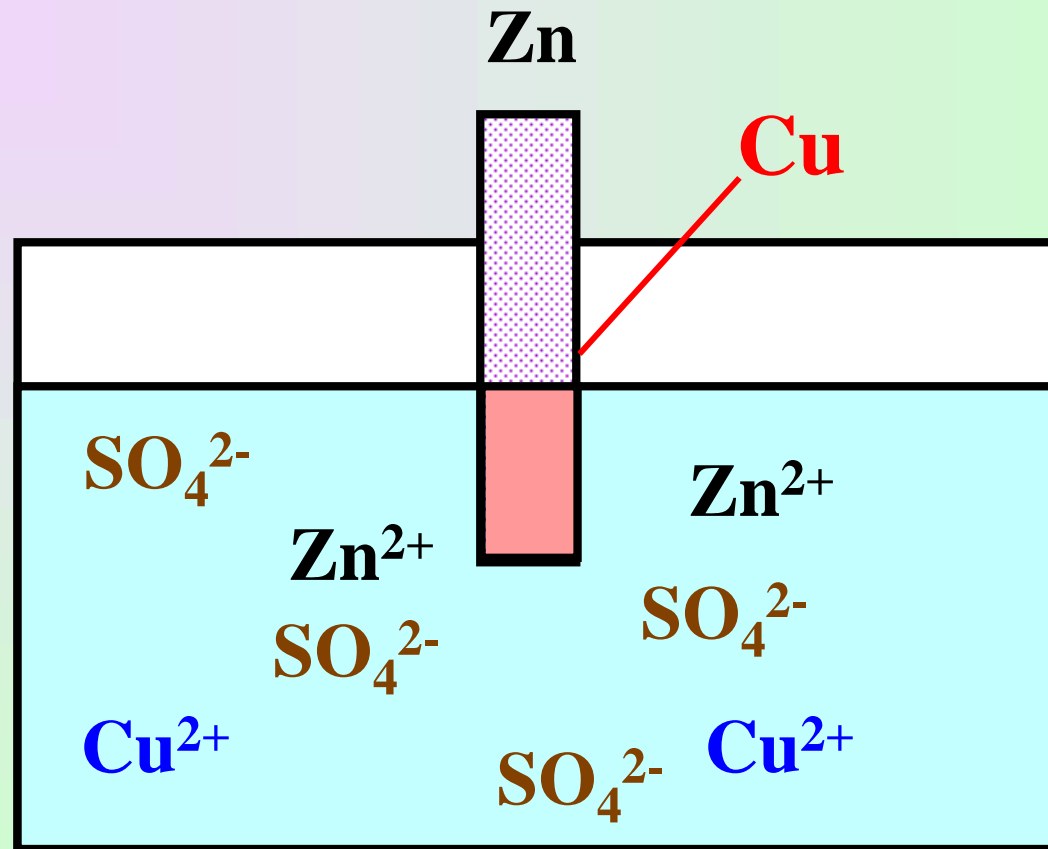




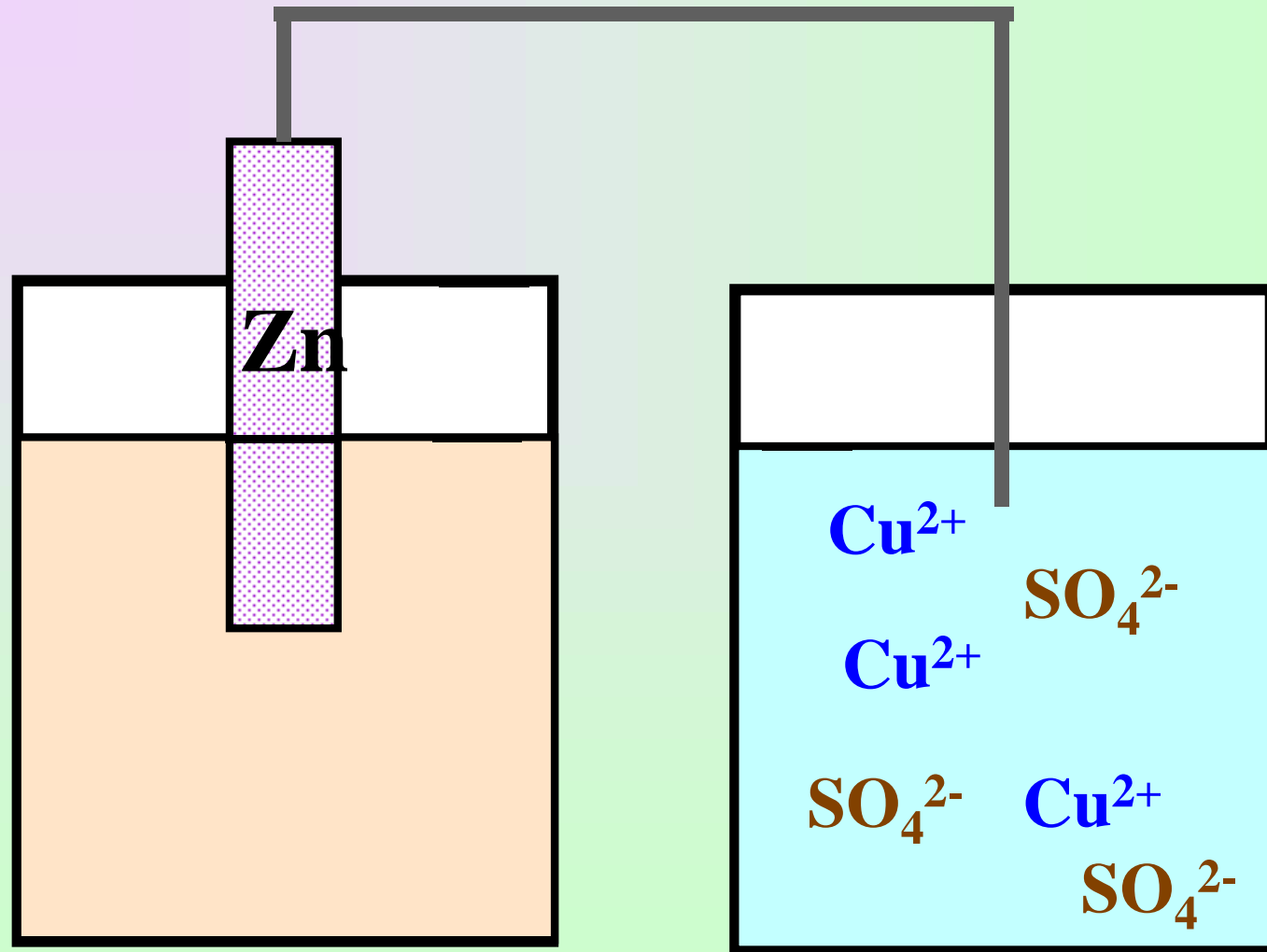




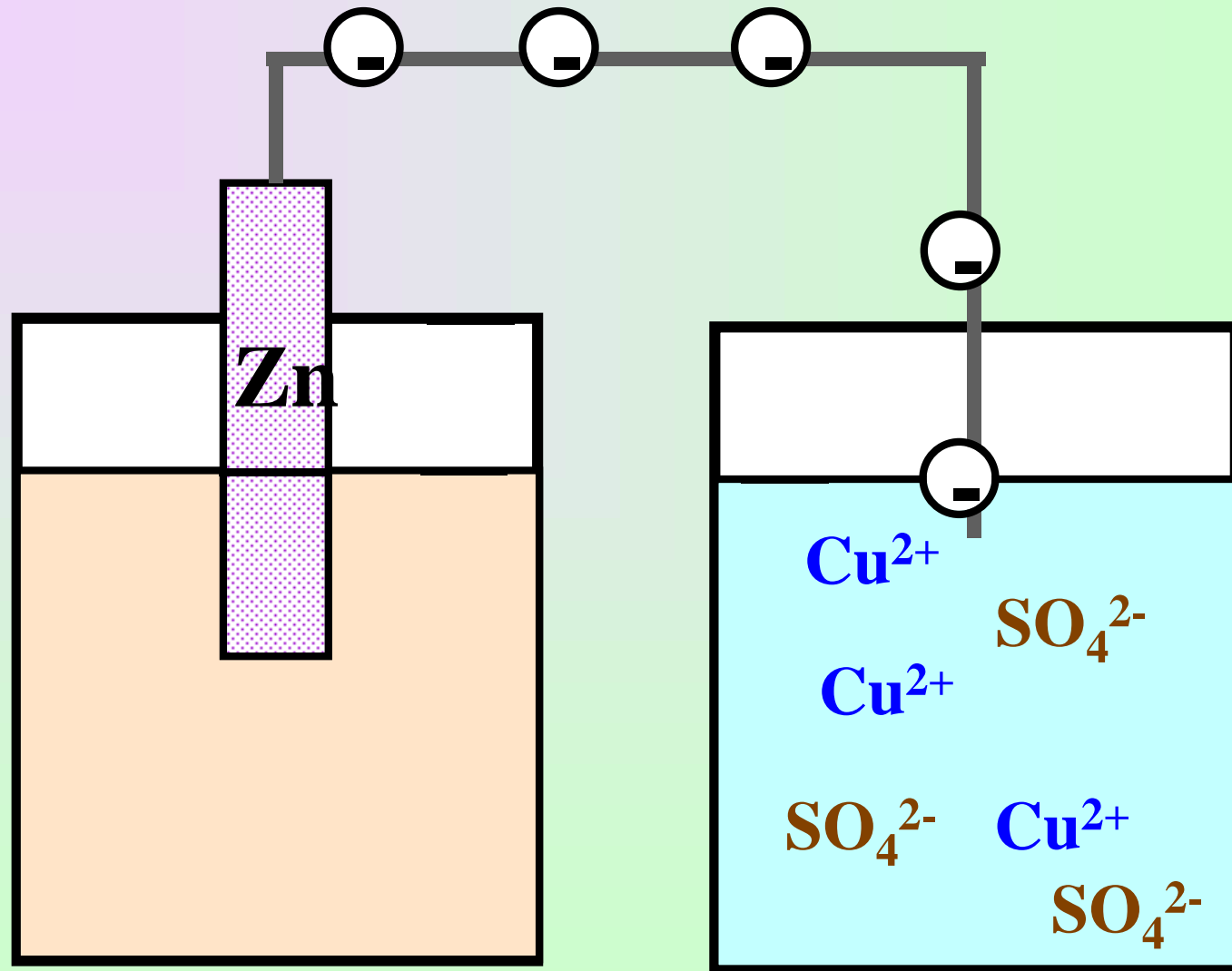
electrons flow but no useful current is generated



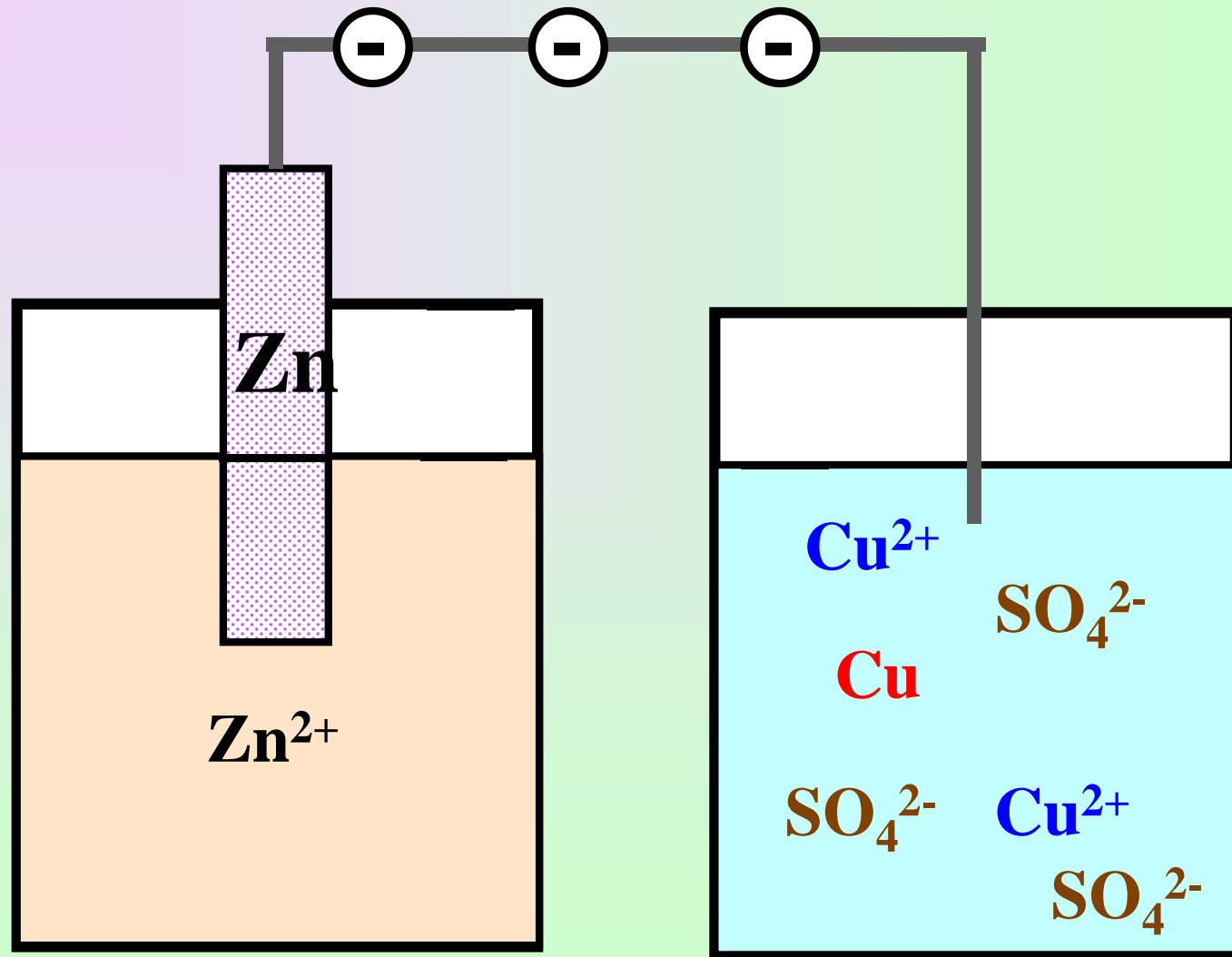
Consider the same two species in separate vessels



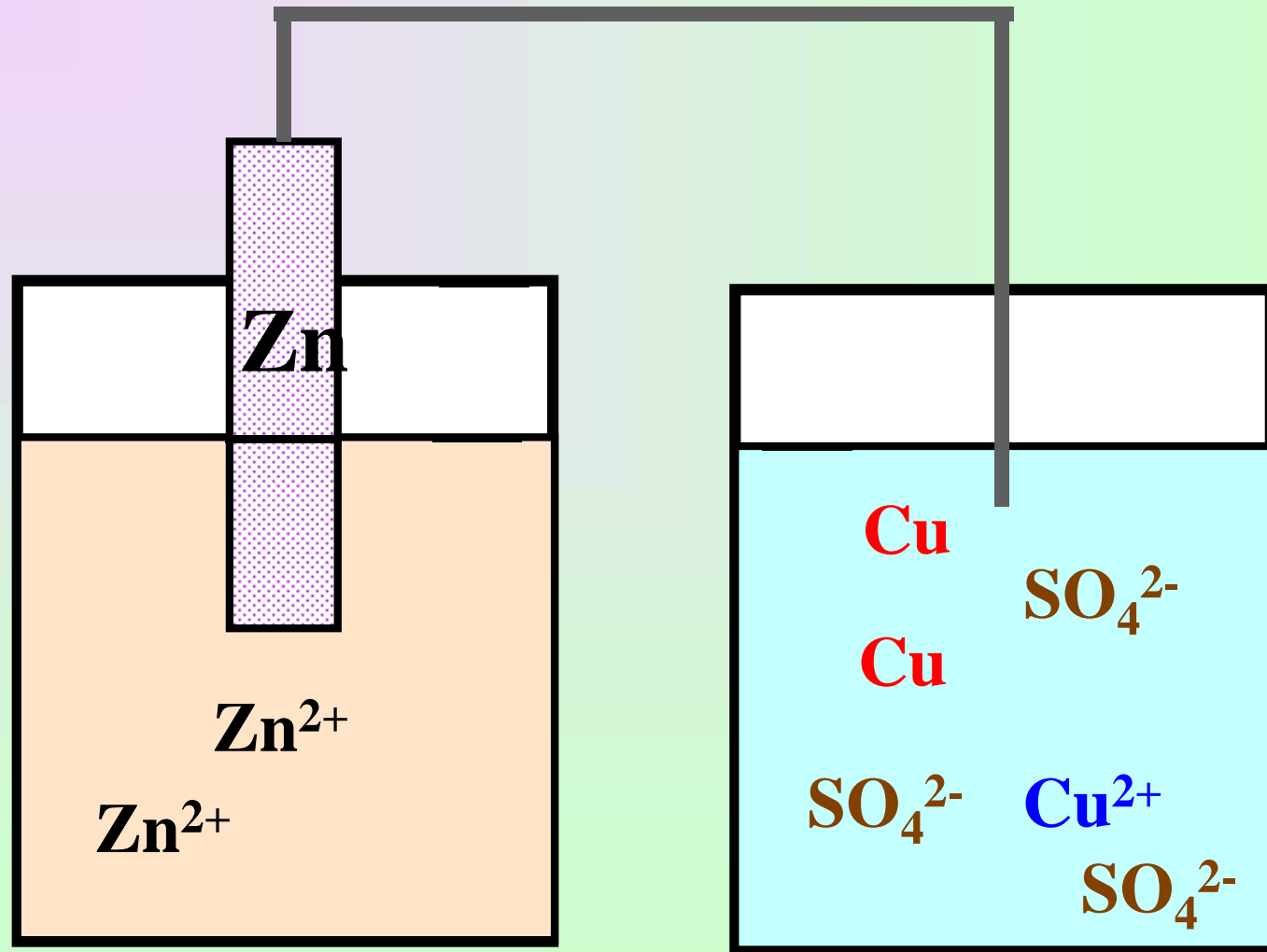
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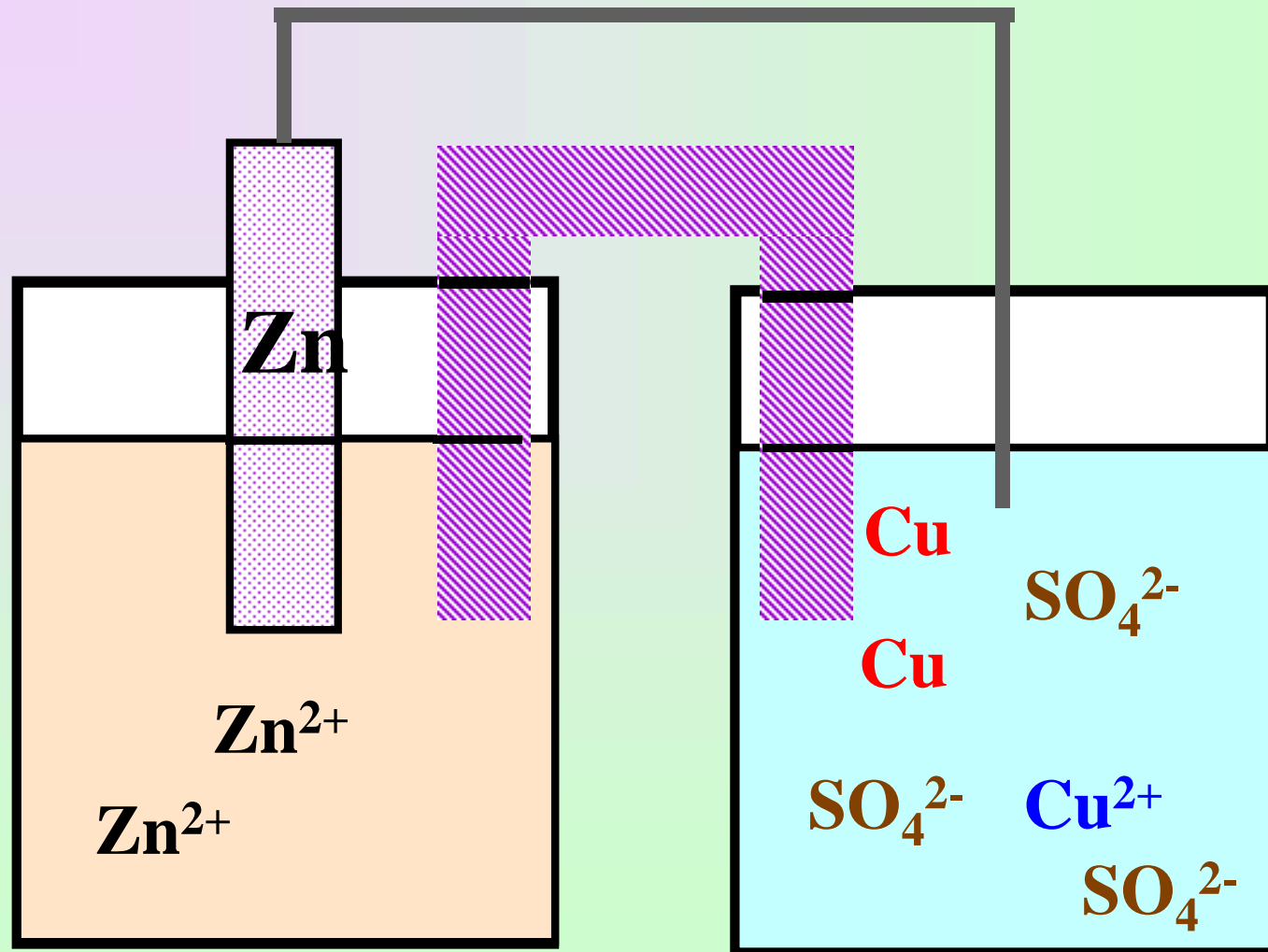
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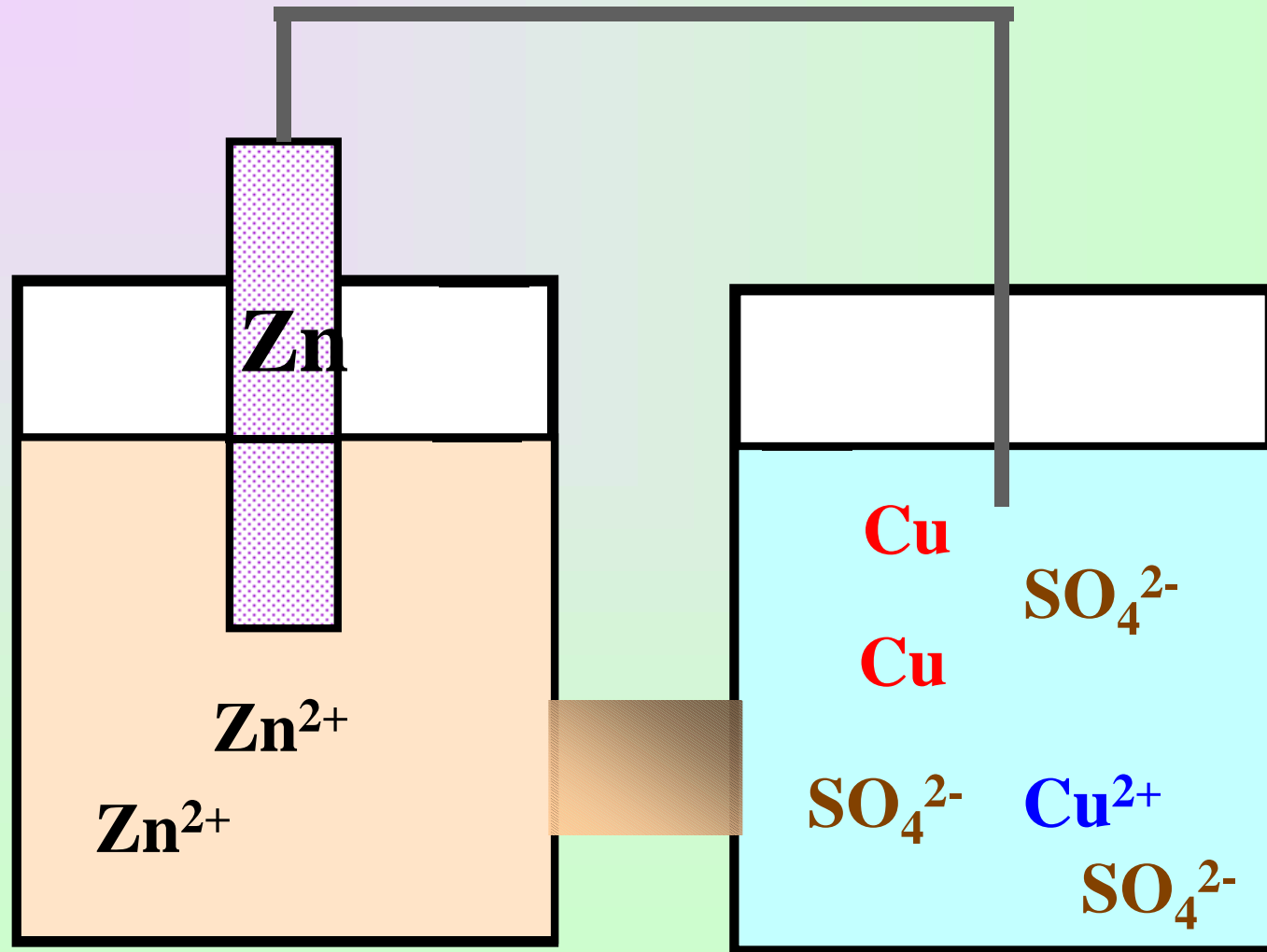
Consider the same two species in separate vessels
electrons soon stop flowing



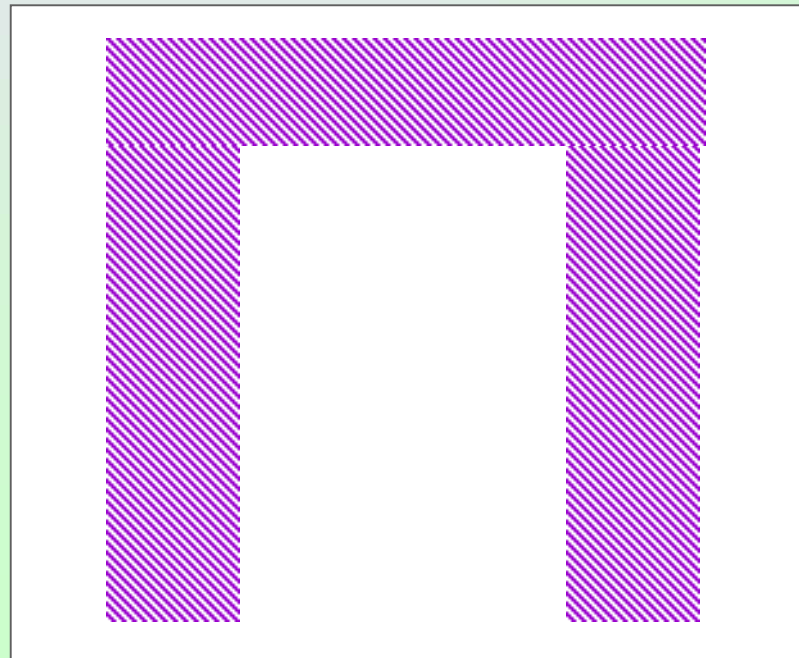
Connect the vessels by a salt bridge



or a porous disk

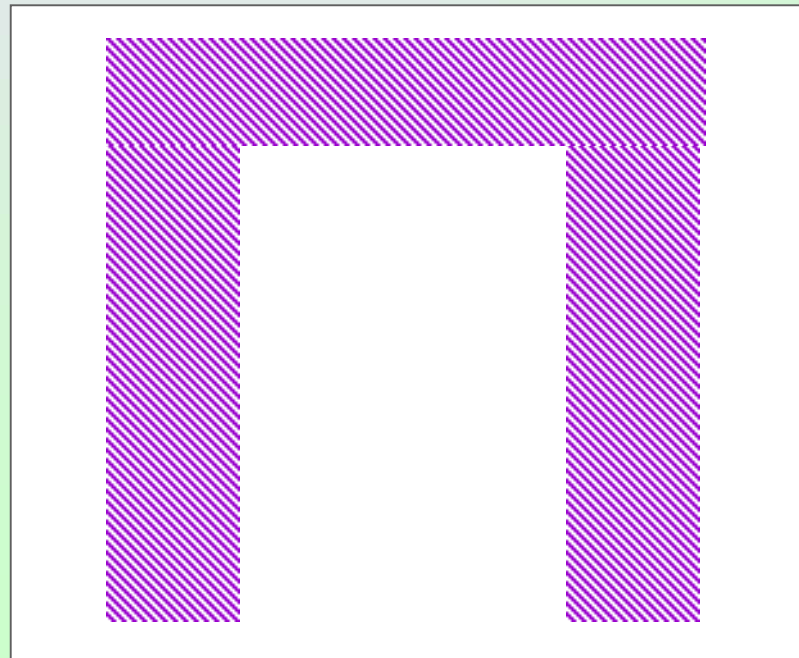


a salt bridge



a salt bridge

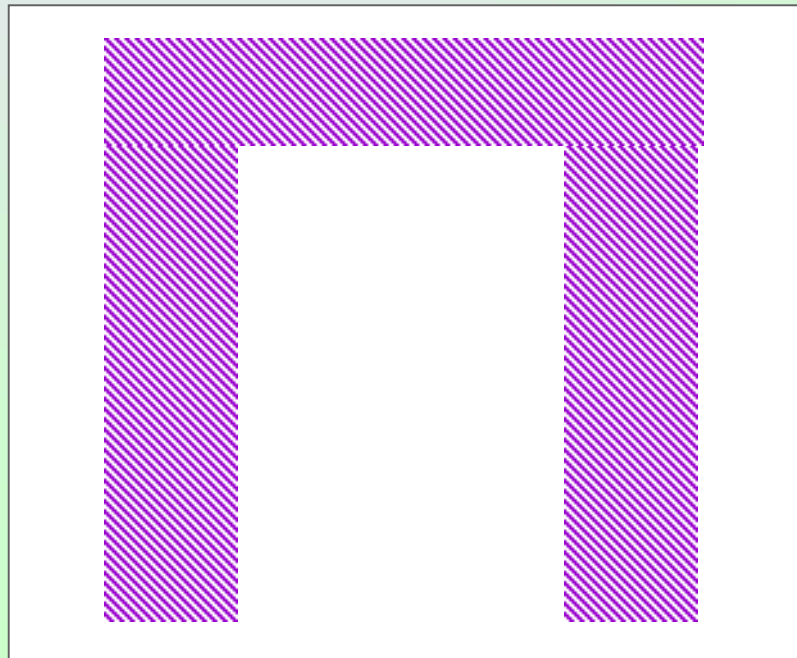
completes the electric circuit



a salt bridge

completes the electric circuit

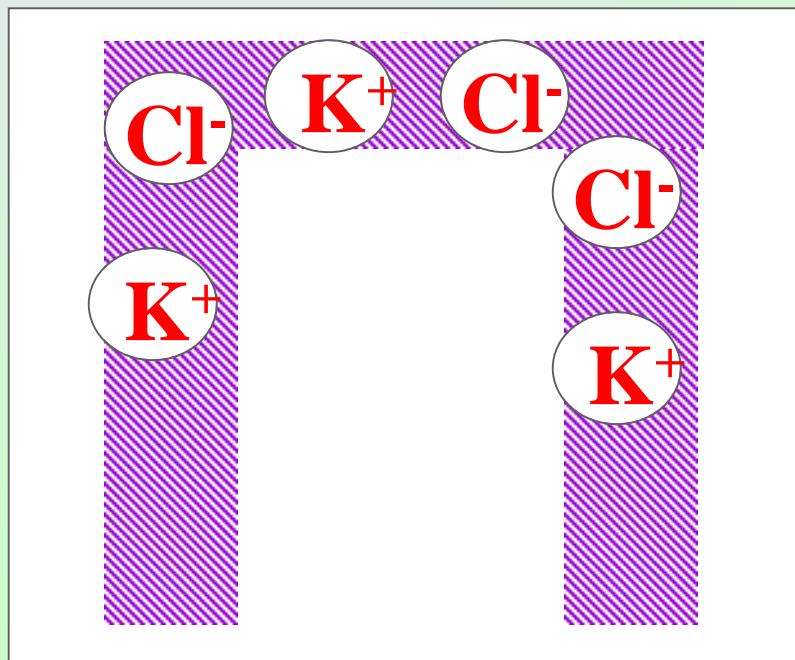
composed of an inert electrolyte (KCl, NH_4NO_3) whose ions will not react with the other ions or electrodes in the cell



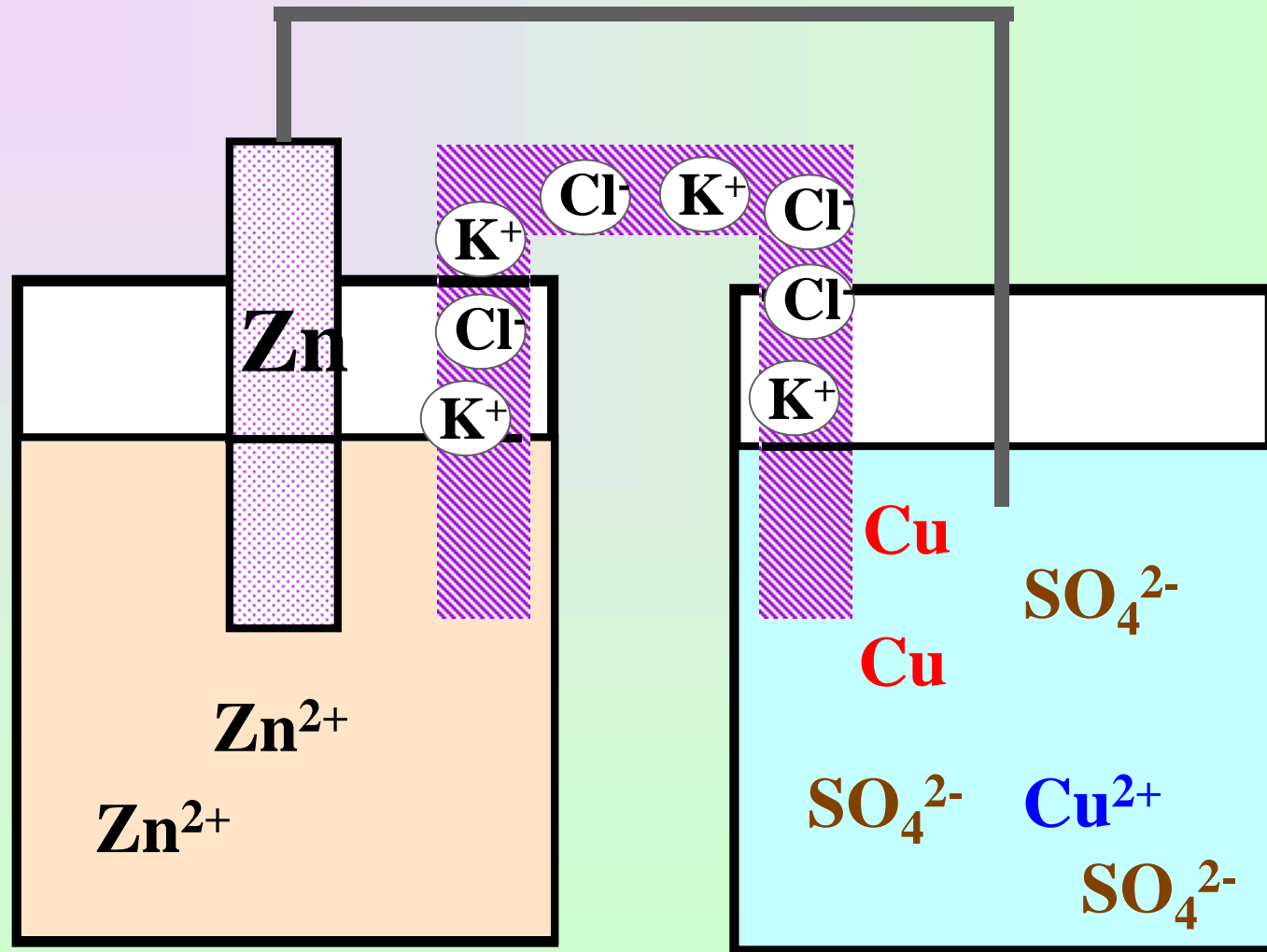
a salt bridge

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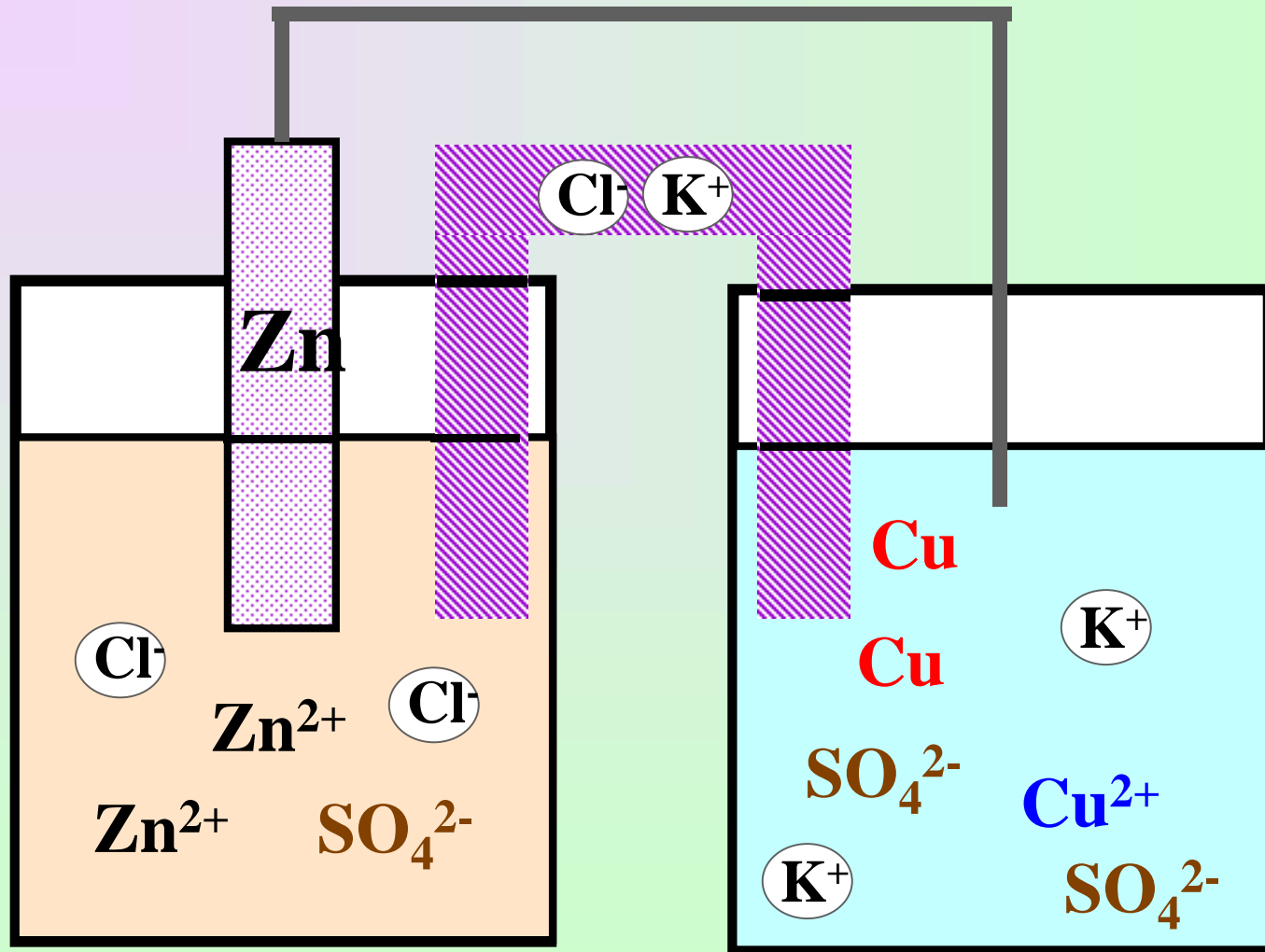
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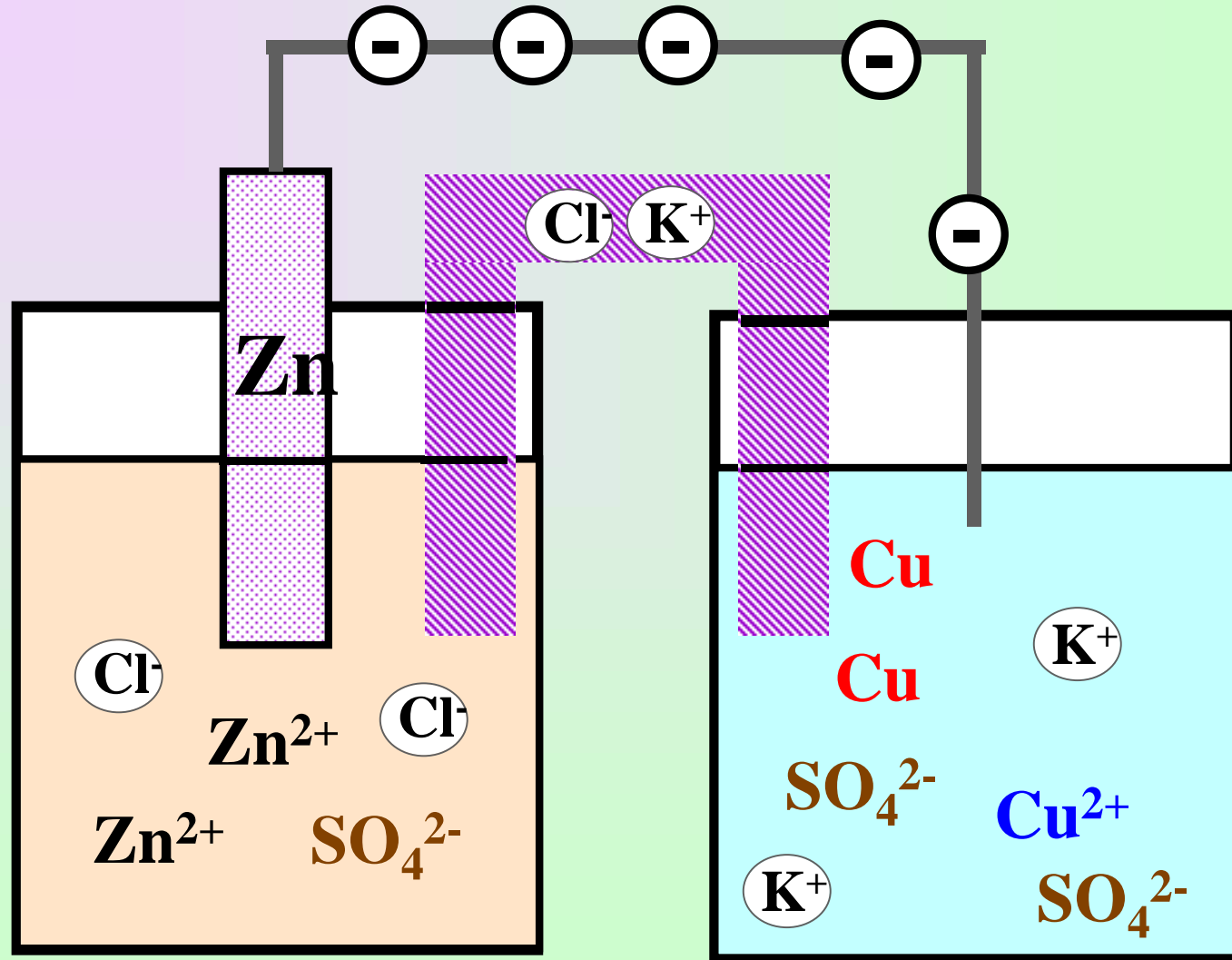
a salt bridge



Ion flow balances charges



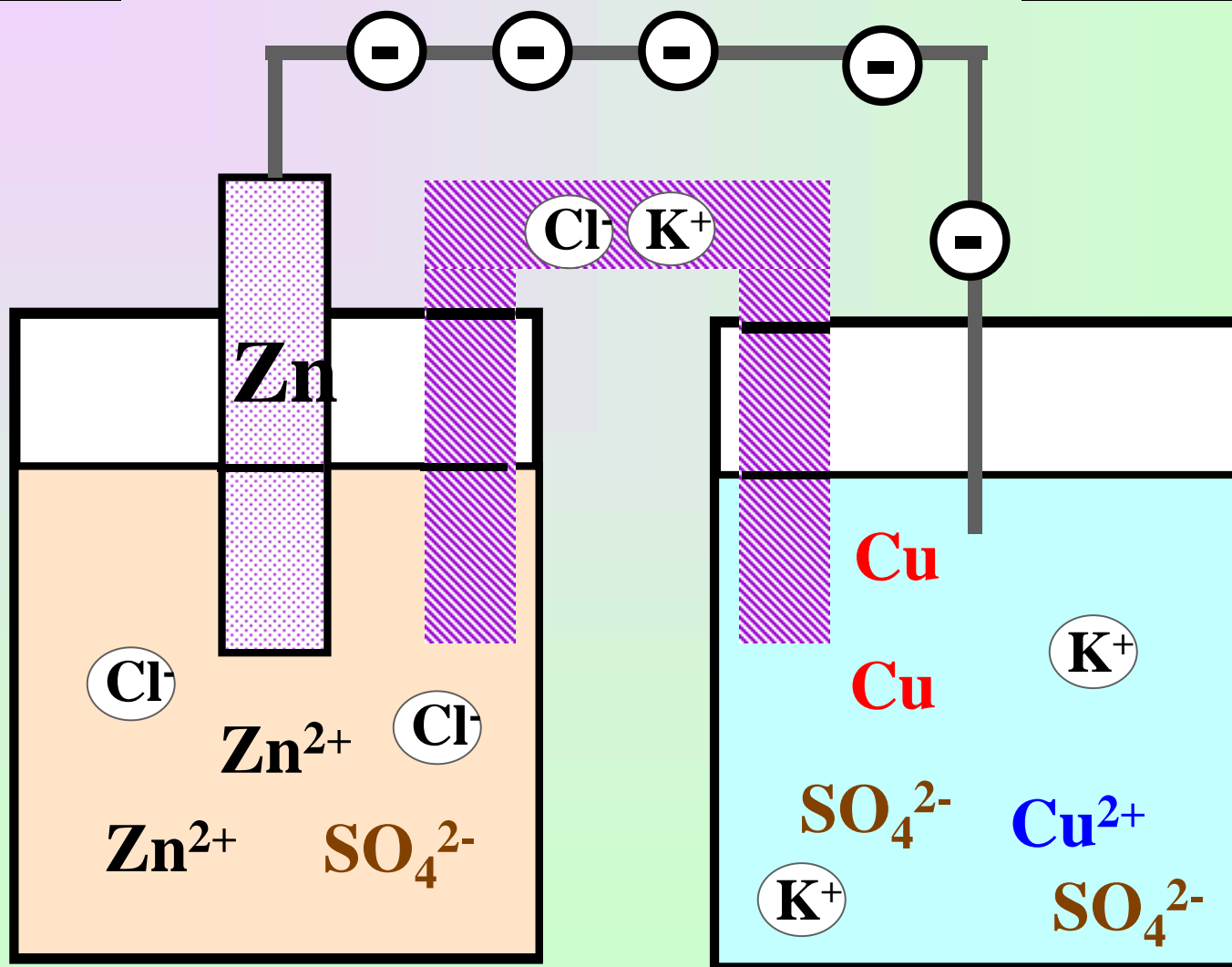
Ion flow balances charges and permits electron flow



Galvanic cell

Anode

Cathode

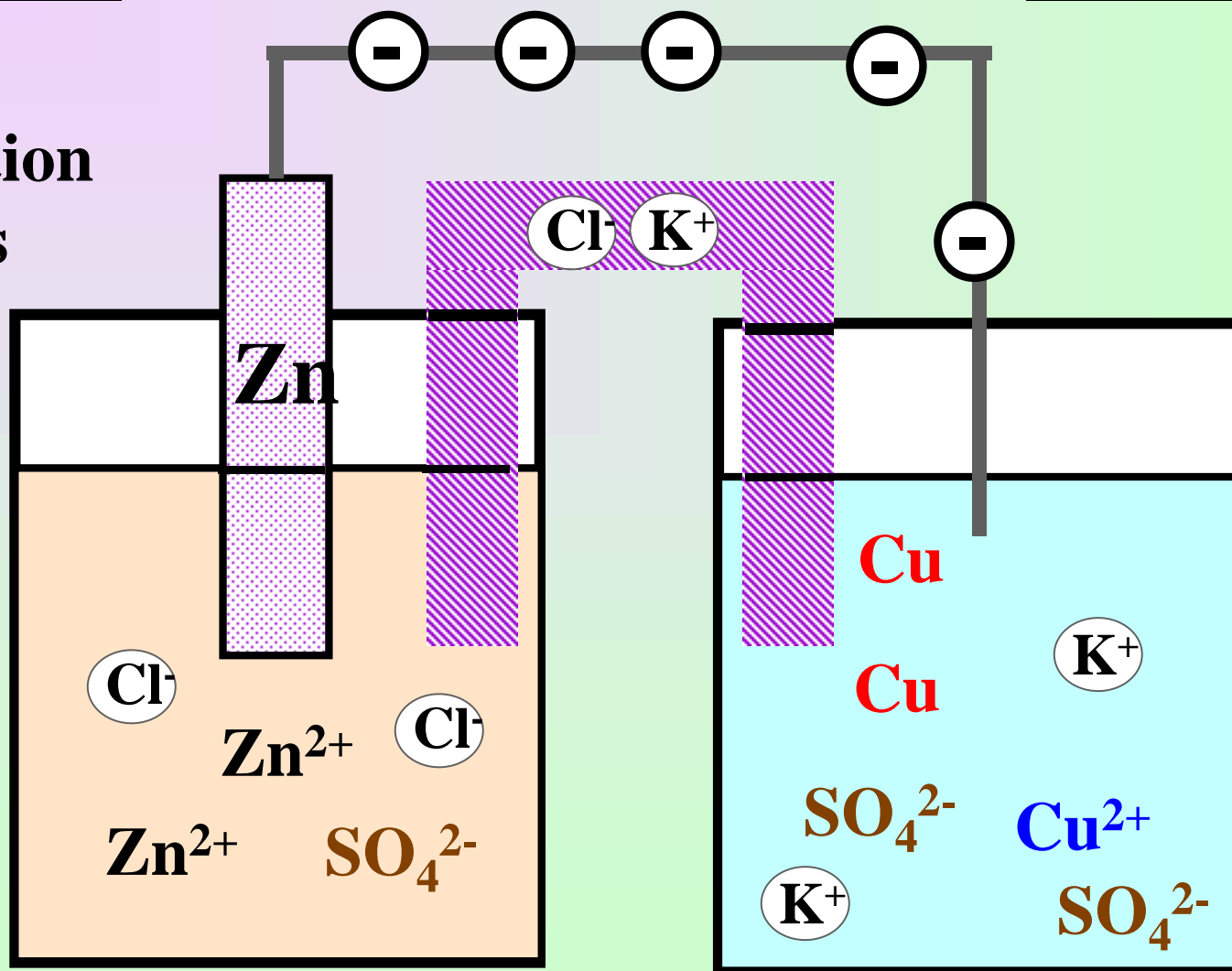


Galvanic cell

Anode

Cathode

where
oxidation
occurs



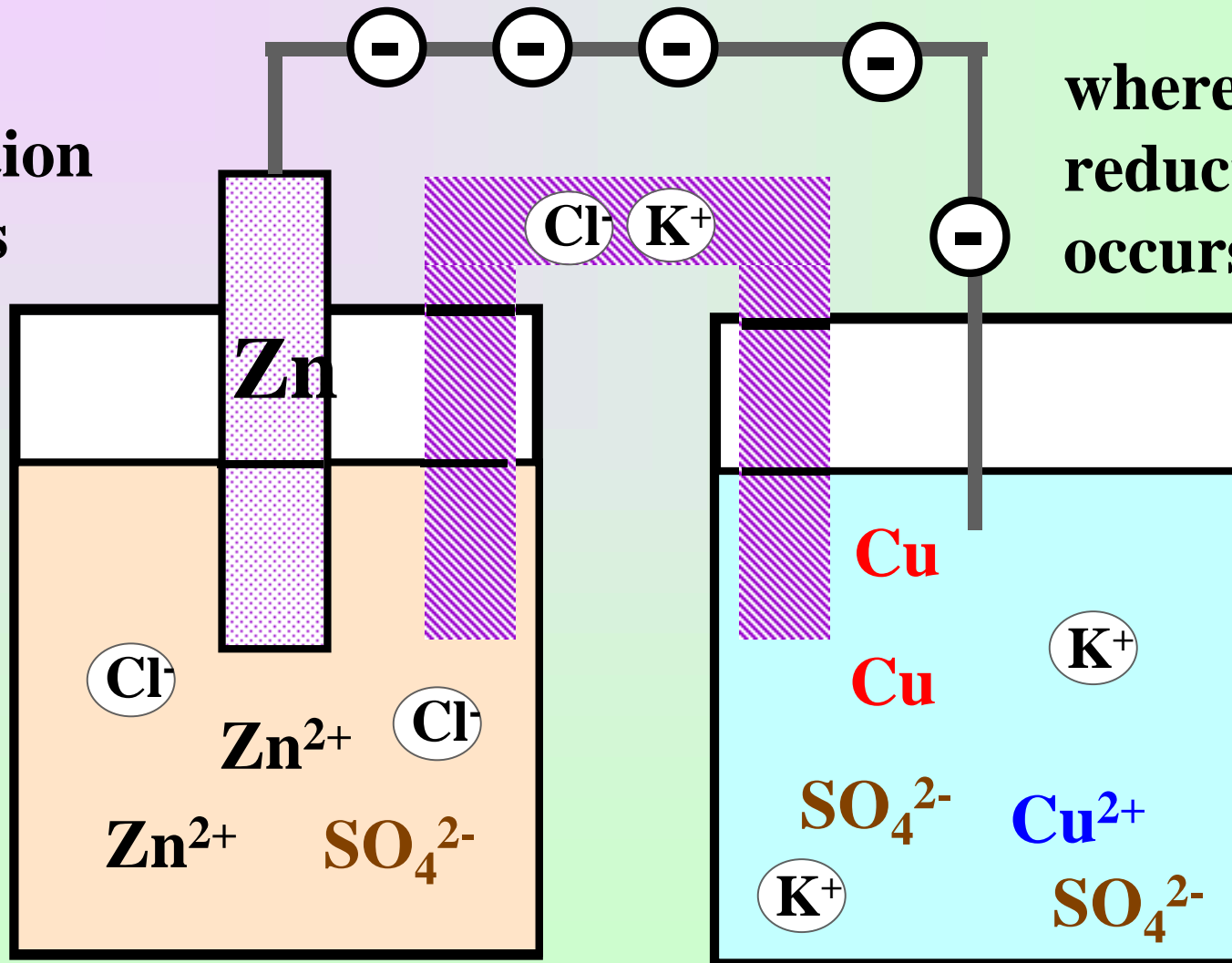
Galvanic cell

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

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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unit is volt (V)

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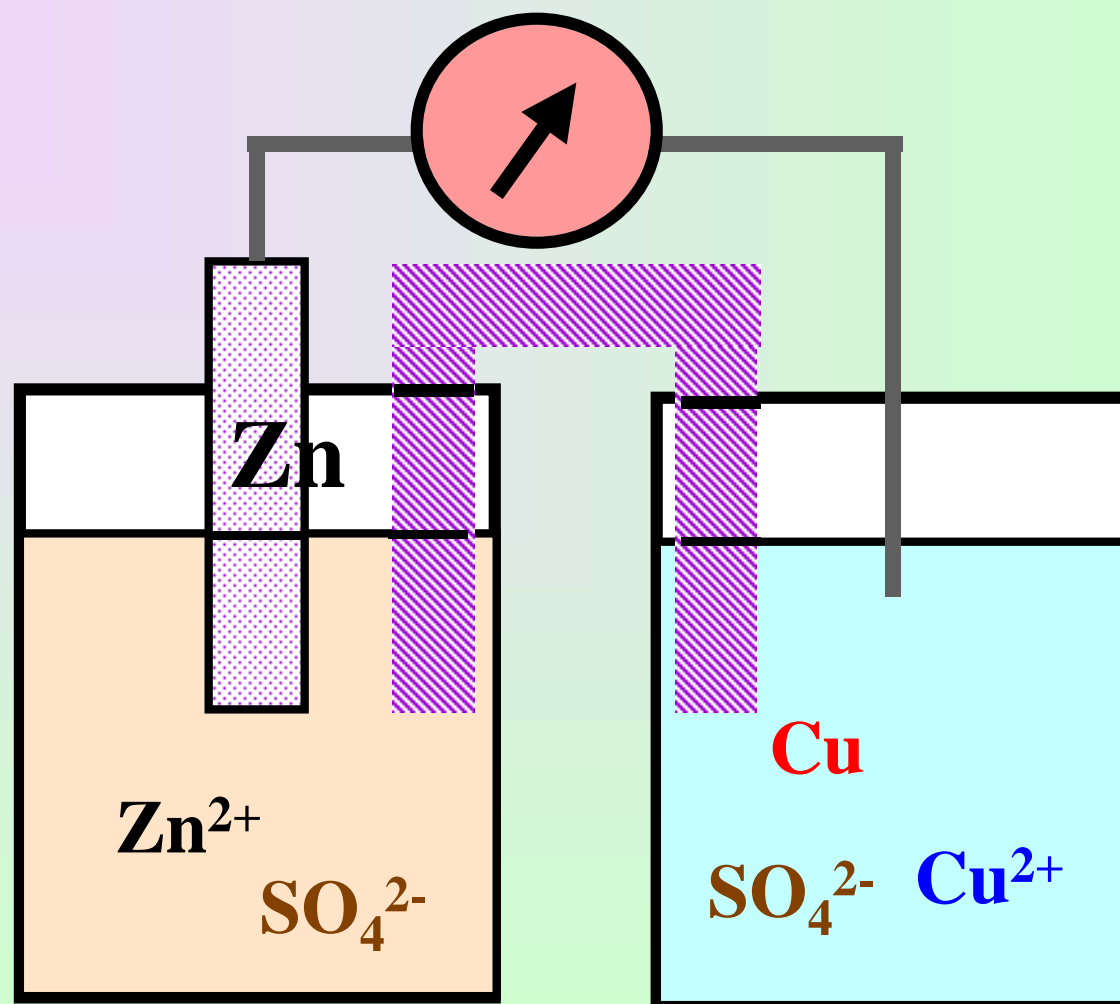
symbol is script E ($\mathcal{E}_{\text{cell}}$)

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