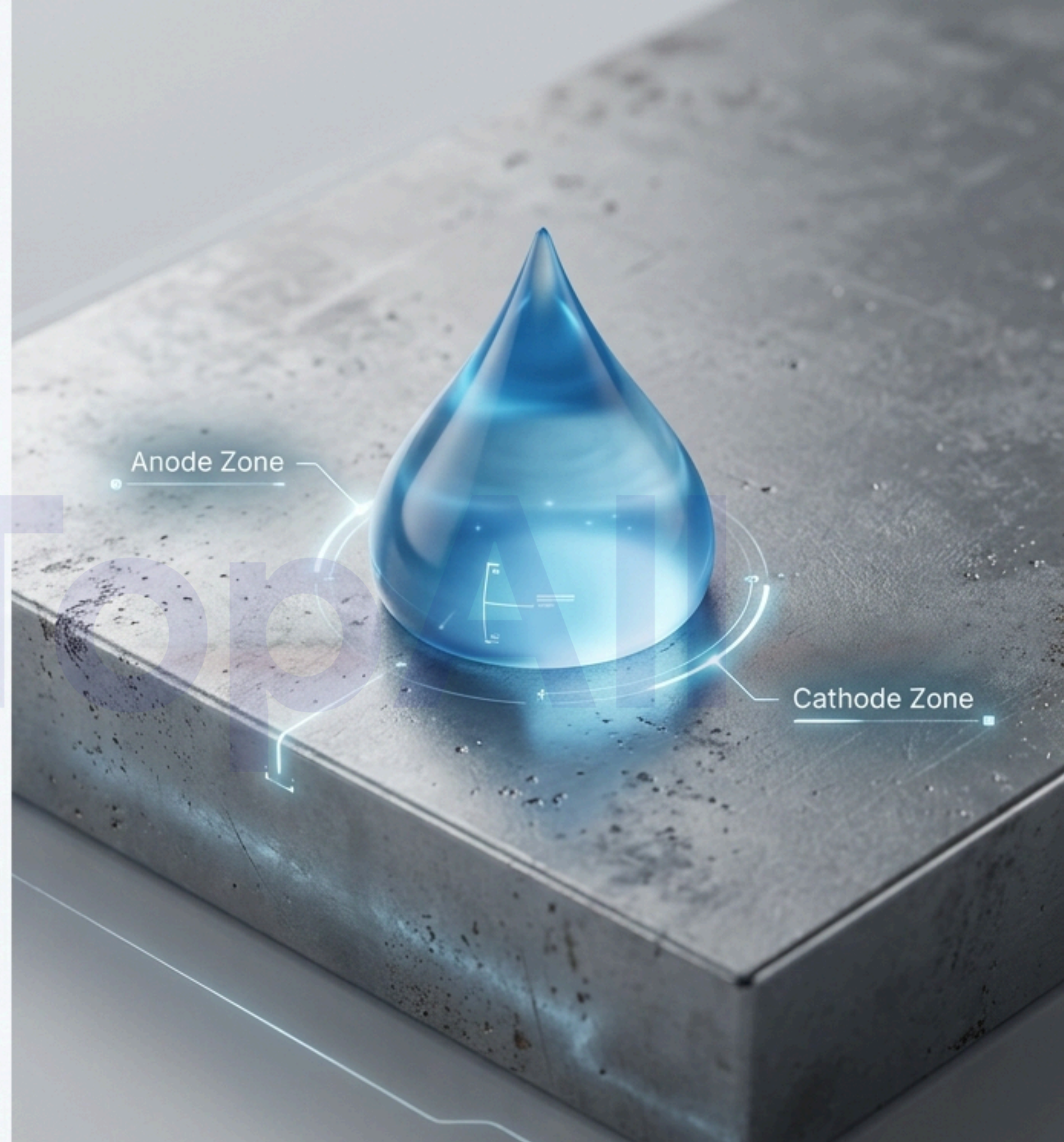


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Corrosion

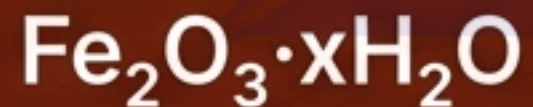
Rusting Is an
Electrochemical Cell



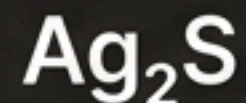
Metals Oxidize to Form Stable Compounds



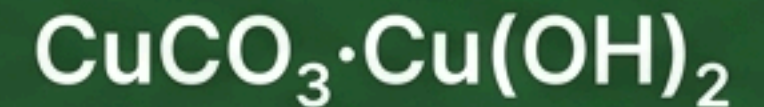
Rusting Iron



Tarnishing Silver



**Green Coating on
Copper/Bronze**



Corrosion is a spontaneous redox process where metals revert to their natural, stable state (oxides/sulphides/carbonates).

The Two Prerequisites for Rusting



Rusting cannot occur in dry air or oxygen-free water. The presence of H^+ (from dissolved CO_2 forming H_2CO_3) accelerates the process by acting as an electrolyte.



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$$E=mc^2$$



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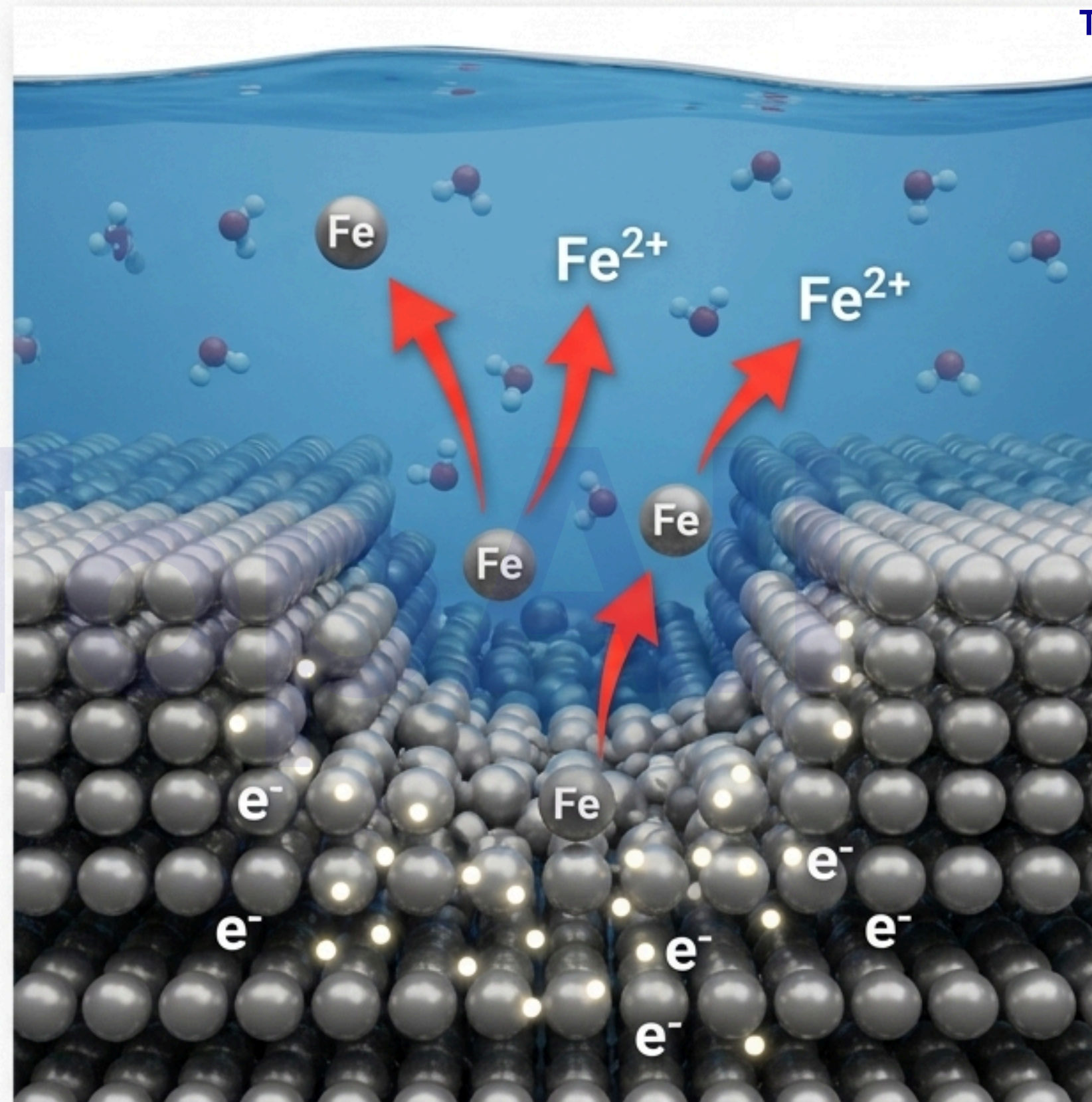
STEP 1: OXIDATION

The Anodic Region



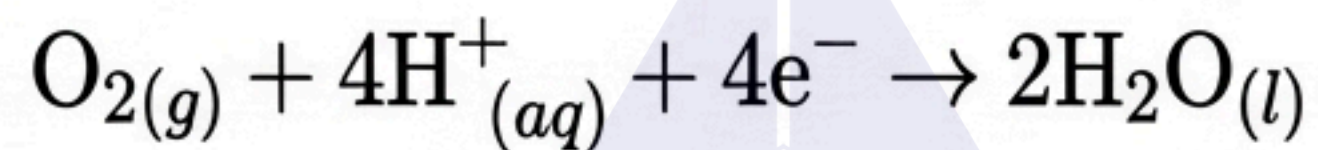
$$E^{\circ}(\text{Fe}^{2+}/\text{Fe}) = -0.44\text{V}$$

A localized spot on the iron object acts as the anode. Iron atoms lose electrons and dissolve into the water droplet as ferrous ions.



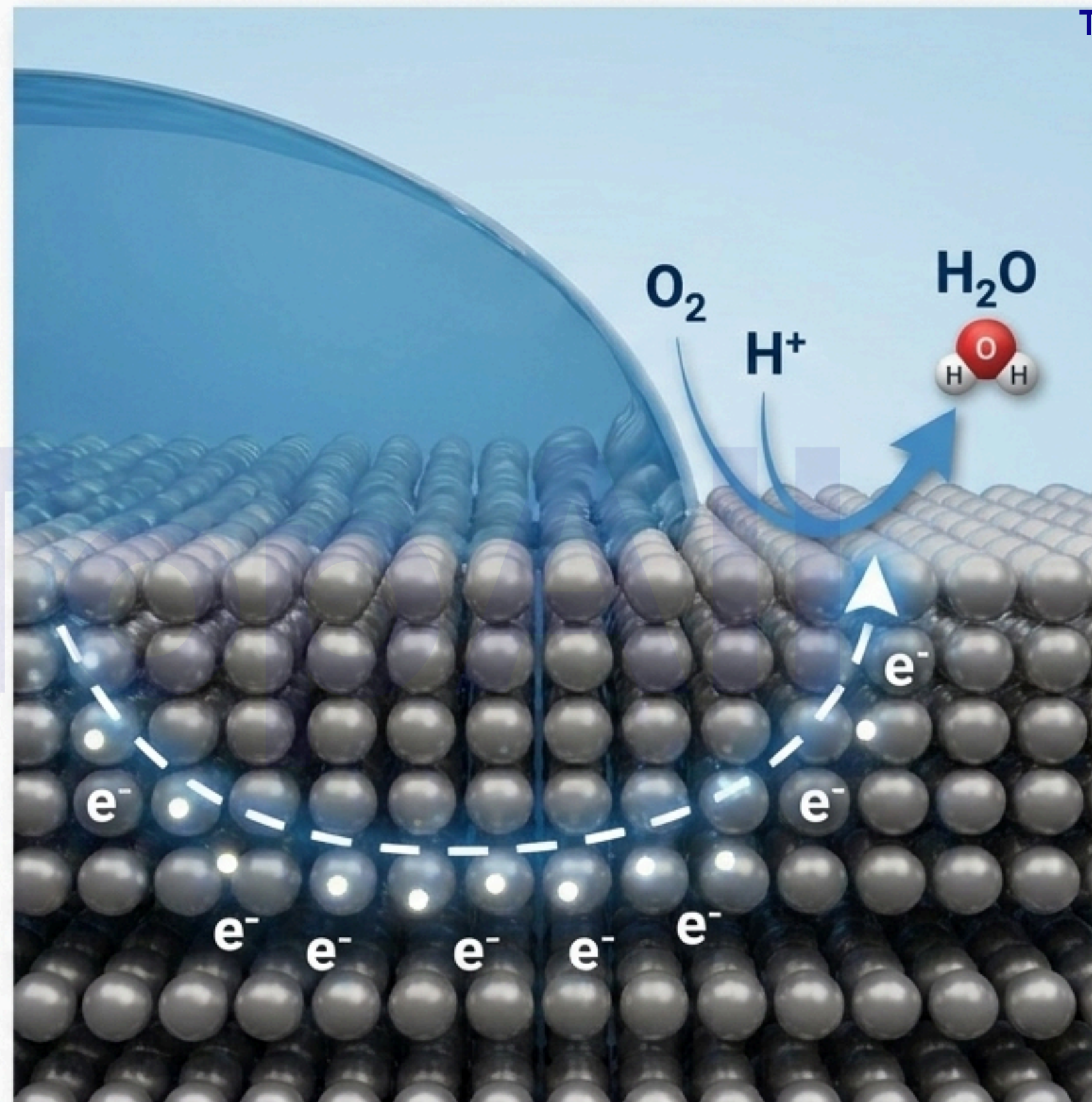
STEP 2: REDUCTION

The Cathodic Region

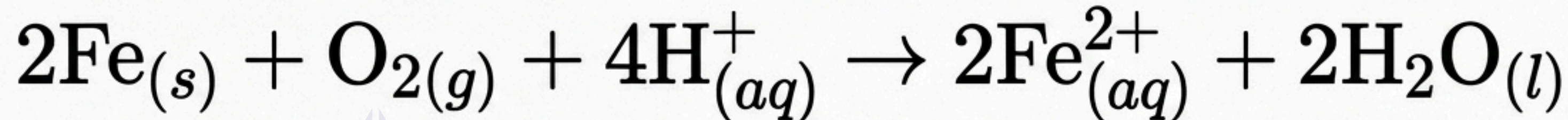


$$E^\circ = +1.23\text{V}$$

Electrons migrate through the metal to another spot (the cathode). Oxygen is reduced in the presence of H^+ (supplied by dissolved atmospheric CO_2).



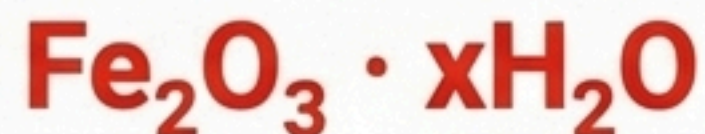
The Net Electrochemical Cell



$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 1.23\text{V} - (-0.44\text{V}) = 1.67\text{V}$$

Atmospheric Oxidation

Ferrous ions are further oxidized to form Rust (Hydrated Ferric Oxide):



TRAP: Rust is NOT Fe^{2+} . The cell produces Fe^{2+} , but atmospheric oxygen further oxidizes it to Fe^{3+} in the final rust layer.

Strategies for Corrosion Prevention



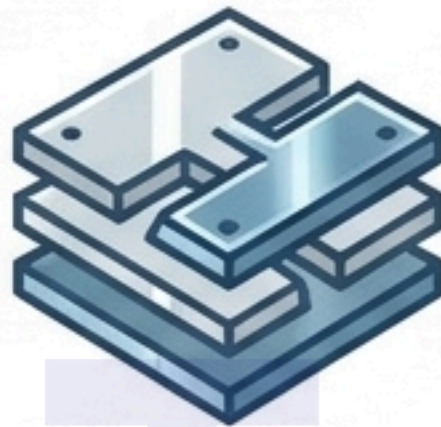
Barrier Protection

Mechanism:

Paint or chemicals (e.g., bisphenol).

Action:

Physically cuts off the supply of O_2 and H_2O .



Inert Metal Coating

Mechanism:

Coating with Tin (Sn) or Zinc (Zn).

Action:

Provides an inert surface shield.



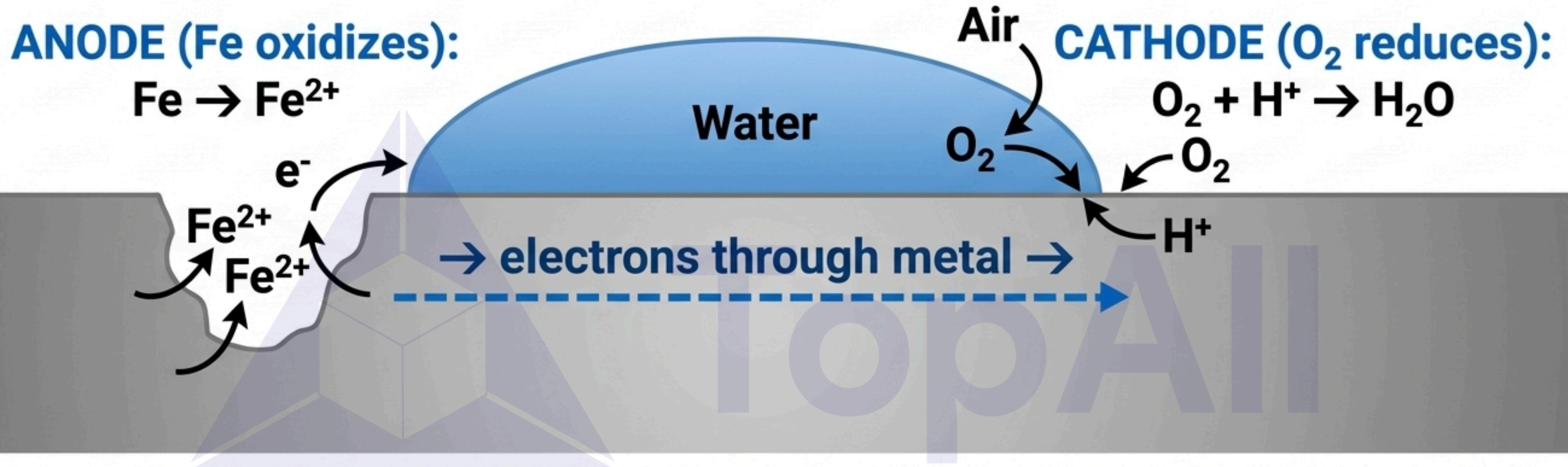
Sacrificial Electrode

Mechanism:

Connecting Mg or Zn to the Iron.

Action: The more reactive metal corrodes first, acting as an artificial anode.

Synthesis: The Rogue Battery



CORROSION = Microscopic electrochemical cells forming spontaneously on a metal surface.



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