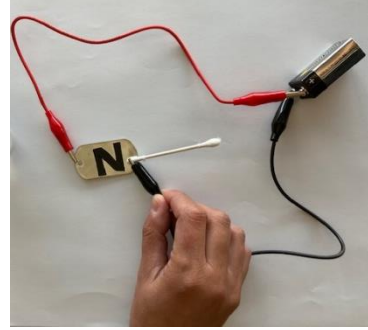


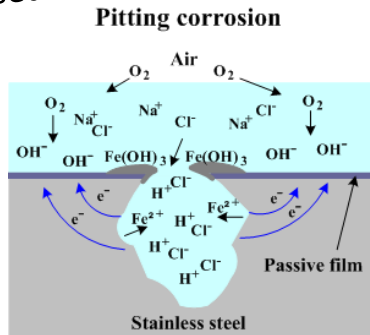
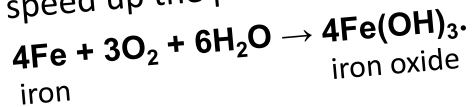
Electrical Etching

1. **Make** design on stainless steel with electrical tape, leaving one edge exposed.
2. **Attach** one end red alligator clip to positive battery terminal, clip other end to stainless steel.
3. **Attach** one end black alligator clip to negative battery terminal, clip other end to tip of cotton swab.
4. **Dissolve** 2 tsp salt in 1 cup water.
5. **Dip** clipped end of cotton swab into saltwater and press on stainless steel. Repeat over entire exposed area.
6. **Peel** away tape when done.



Rusting Out

Rust is created by the reaction of iron and oxygen in water. Iron becomes oxidized, losing electrons to oxygen, leaving soluble iron ions. The iron ions react with hydroxide ions from the water to form **iron oxide**, or rust. The more easily electrons flow from iron to oxygen, the quicker the metal rusts. Salt and acid have more dissolved ions and speed up the process.



It's the Pits

Stainless steel is an iron-chromium alloy with a passive chromium-oxide film that resists rusting. However, the chlorine ion (Cl⁻) in saltwater disrupts the oxide to form soluble iron chloride. This dissolves in water, leaving a pit behind. Known as **pitting corrosion**, electricity speeds up the process to etch the metal. Using a positive charge on the metal attracts negatively charged chloride ions while also removing electrons from the iron, converting it into soluble iron ions (Fe²⁺) to eventually form iron oxide, or rust.

NAVY NOTES



Sacrificial anodes are attached to ships and marine structures to protect them from corrosion caused by the flow of electrons between metal surfaces. Most anodes are made of zinc, but the Navy is researching new alloys that are less toxic and less expensive.