

## What is steel?



Steel is a mixture of a small amount of carbon in iron. The carbon dissolves in the iron and makes it stronger but also more brittle. Steel has been made for thousands of years by reducing iron ores with carbon.

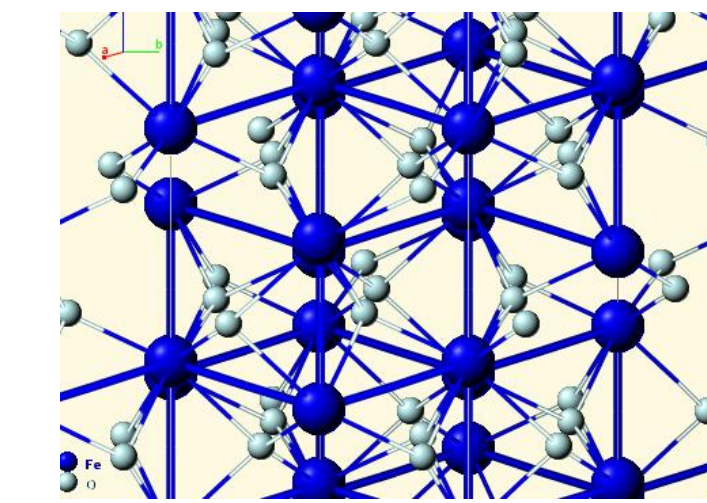
## Do other metals corrode?



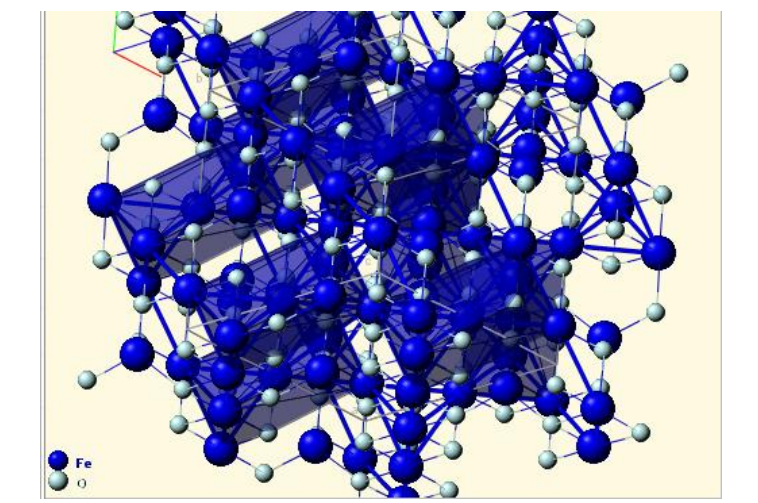
All metals apart from gold and platinum corrode at some rate. However, some metals like aluminum and titanium form oxide layers which are inert to oxygen. This allows titanium to be used in medical implants despite its high price.

## What are iron oxides like?

On an atomic scale the various iron oxides consist of oxygen atoms which get extra electrons from the iron atoms. Nominally the charge on oxygen is -2 whilst iron can have 3+ in hematite and a mixed charge in magnetite. In reality the electrons are partially shared.



Hematite



Magnetite

## Why do metals corrode?



Metals corrode because they react with oxygen and water in the atmosphere. This results from the tendency of energy to become less concentrated

with time. Making metals from ores uses concentrated energy sources. Corrosion disperses this energy in the environment. Some metals like gold take energy to oxidise and are thus naturally found in a metallic state.

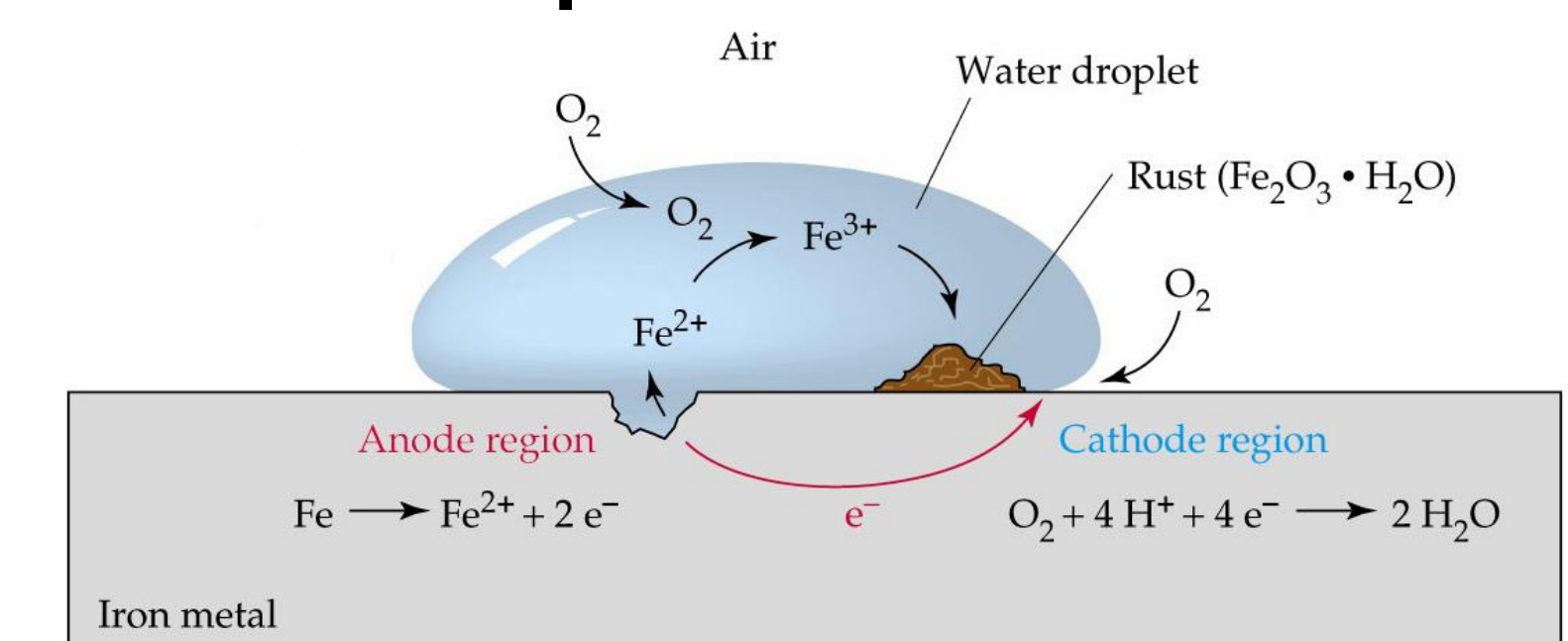
## What is rust?



Rust is not one thing, it refers to many different oxides and hydroxides of iron. Rust is usually mostly hematite, which has the chemical formula  $\text{Fe}_2\text{O}_3$ . This compound has three oxygen atoms for every iron atom and gives rust its red colour. In humid air also  $\text{FeOOH}$  is formed.

## How does steel corrode ?

In open air, steel corrodes via a complex electrochemical process. In small pits iron dissolves to form  $\text{Fe}^{2+}$  which is further oxidised to  $\text{Fe}^{3+}$ . This liberates electrons allowing oxygen and water to make hydroxide. This then forms  $\text{Fe}_2\text{O}_3$ , which forms a porous film on the steel.



# Steel, Rust and Corrosion