

## **SURFACE OXIDES IN METALLIC CORROSION**

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### **ABSTRACT**

Depending on their ionic and electronic properties, surface oxides either accelerate or decelerate the corrosion of metals in aqueous solutions. For porous surface oxides, the ion-selective property controls the transport of ions through the surface oxide to determine the corrosiveness of the aqueous solution on the metal surface, and the electronic property of the oxide affects the electrode potential of corroding metals influencing the corrosion rate. Anion-selective surface oxides accumulate corrosive anions accelerating the metallic corrosion, whereas cation-selective oxides inhibit the corrosion by removing corrosive hydrogen ions from the metal surface. The presence of n-type surface oxides lowers the electrode potential to decrease the metallic corrosion, while p-type surface oxides raise the potential accelerating the corrosion. Photoexcitation enhances these electronic effects of semiconducting surface oxides on the corrosion. For compact surface oxides, the passive oxide films are corrosion-resistive as long as the Fermi level remains within the electronic band gap at the film surface. The potential-dependent film dissolution of the transpassive mode occurs when the Fermi level is pinned at the valence band on the film surface. The chloride-breakdown of the passive film results from the formation of ionic and electronic defects on the film surface. The film breakdown site either grows into stable pitting or repassivates itself depending on whether the film-breakdown potential is more anodic or less anodic than the pit-repassivation potential.