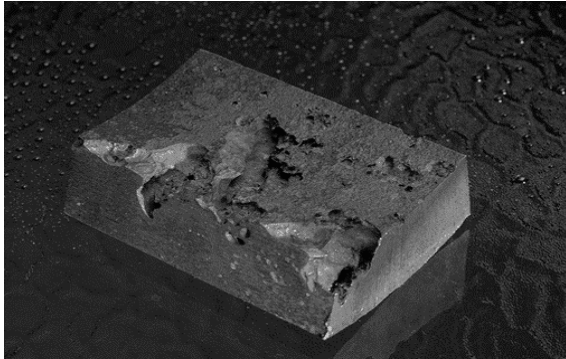


ChE430 (530)

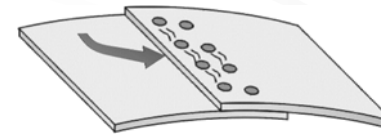
Metallic corrosion



courtesy 

ChE430 (530)

Metallic corrosion



Significance and cost of corrosion

Introduction

- ▶ Significance and cost of corrosion
- ▶ Definitions and underlying mechanisms
- ▶ Forms of corrosion
- ▶ Corrosion rate measurements

Electrochemical thermodynamics

Electrochemical kinetics

Corrosion rate measurements

Various forms of corrosion

Corrosion mitigation

- The total direct cost of corrosion in 1998 in the US is estimated at \$276 billion per year, which is 3.1 % of the U.S. gross domestic product (GDP).
- This cost was determined by analyzing 26 industrial areas, in which corrosion is known to exist, and extrapolating the results for a nationwide estimate.

Direct costs...

across five major sectors:

Introduction

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Various forms of corrosion

Corrosion mitigation

- Infrastructure	\$ 22.6 billion
- Utilities	\$ 47.9 billion
- Transportation	\$ 29.7 billion
- Manufacturing	\$ 17.6 billion
- Government	\$ 20.1 billion
<hr/>	
- Total:	\$137.9 billion

Indirect costs...

Introduction

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Electrochemical thermodynamics

Electrochemical kinetics

Corrosion rate measurements

Various forms of corrosion

Corrosion mitigation

- conservatively estimated to be equal to the direct cost (another \$137.9 billion)
 - plant downtime
 - loss of production
 - loss of efficiency
 - contamination (pollution)
 - overdesign

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Preventive strategies

Introduction

- ▶ Significance and cost of corrosion
- ▶ Definitions and underlying mechanisms
- ▶ Forms of corrosion
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Electrochemical thermodynamics

Electrochemical kinetics

Corrosion rate measurements

Various forms of corrosion

Corrosion mitigation

- increase awareness of large corrosion costs and potential savings
- change the misconception that nothing can be done about corrosion
- change policies, regulations, standards, and management practices to increase corrosion savings through sound corrosion management
- improve education and training of staff in recognition of corrosion control

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Preventive strategies (continued)

Introduction

- ▶ Significance and cost of corrosion
- ▶ Definitions and underlying mechanisms
- ▶ Forms of corrosion
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Electrochemical thermodynamics

Electrochemical kinetics

Corrosion rate measurements

Various forms of corrosion

Corrosion mitigation

- advance design practices for better corrosion management
- advance life prediction and performance assessment methods
- advance corrosion technology through research, development, and implementation

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Definitions

Introduction

- ▶ Significance and cost of corrosion
- ▶ Definitions and underlying mechanisms
- ▶ Forms of corrosion
- ▶ Corrosion rate measurements

Electrochemical thermodynamics

Electrochemical kinetics

Corrosion rate measurements

Various forms of corrosion

Corrosion mitigation

- Corrosion is any process involving the deterioration or degradation of metal components
- Corrosion of metals happens through an unintentional chemical or electrochemical action, starting at its surface
- Corrosion is extractive metallurgy in reverse
- Corrosion is electrochemical in nature

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Electrochemical nature of corrosion

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Electrochemical thermodynamics

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Corrosion rate measurements

Various forms of corrosion

Corrosion mitigation

- overall reaction:



- anodic reaction: $Fe \rightarrow Fe^{++} + 2e^-$

- cathodic reactions: $H^+ + e^- \rightarrow \frac{1}{2}H_2$

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Electrochemical nature of corrosion

Introduction

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Various forms of corrosion

Corrosion mitigation

