PAUL SCHERRER INSTITUT

Elektrochemie – P. Novák

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**Übung 12: Corrosion**

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Please send the solved exercise in **English** by e-mail or by post, to be received before the **15.01.2018**.

**Exercise 1. General questions:** (10 points)

a) Explain what is corrosion and what is the difference to erosion. Give an example for both processes.

b) Schematically draw an iron surface in contact with water. Which reactions are occurring on the iron surface during corrosion? Where are the cathode and the anode?

c) What is the mixed potential?

d) What is the Flade potential? Draw the current-voltage curve.

e) Briefly explain a method that you can use to protect an iron from corrosion rod in atmosphere.

**Exercise 2. Pourbaix diagram:** (5 points)

Given the Pourbaix diagram in Figure 1, answer the following questions:

a) Describe what the vertical, horizontal and diagonal lines mean.

b) What are the dashed lines? Why are they shown?

c) Write the equilibria reactions for points A, B and C.

d) Given the following parameters, which processes will occur? Write the expected product.
   i. pH = 12, E = -1.2 V :
   ii. pH = neutral, E = 0.8 V :
   iii. solution of HCl 0.0025 M, E = 0 V :

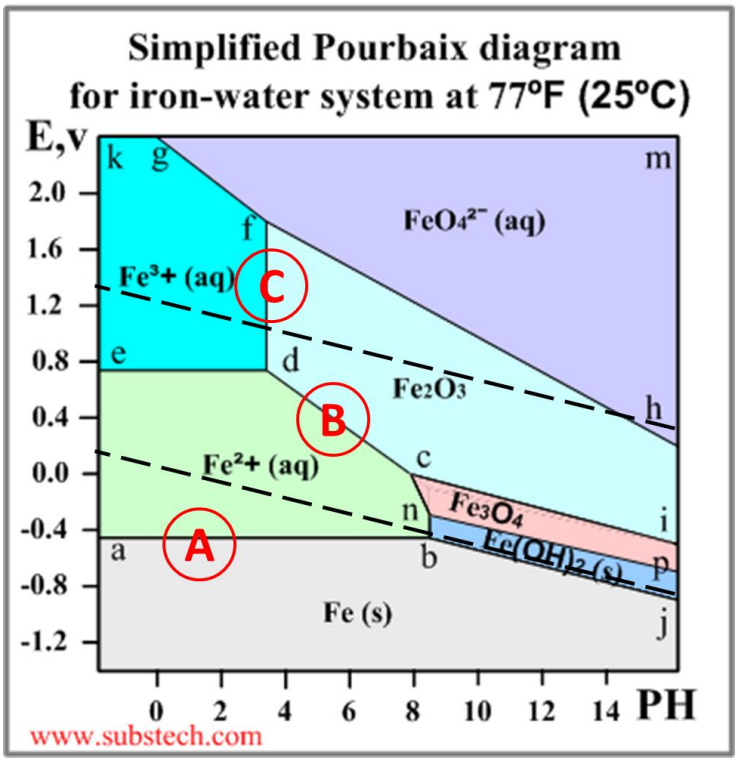


**Figure 1: Pourbaix diagram of the Fe-water system.**

**Exercise 3.** (3 points)

An iron piece is connected to a copper one and both parts are immersed in a solution containing both $Fe^{2+}$ and $Cu^{2+}$ ions. Answer the following questions.

a) Which metal corrodes? Give an explanation.

b) Which one is the cathode? Write the equations occurring at each electrode, assuming each metal has a valence of 2.

c) Calculate the potential of the resulting corrosion cell.

**Exercise 4.** (2 points)

Express the standard Gibbs free energy ΔG° in terms of the standard electrode potential E°. Calculate the value of ΔG° at standard temperature and pressure for the corrosion of iron in the previous exercise. What does a negative ΔG° indicate?