

Name: _____

Homework for Lecture 28, 29

To protect a piece of iron (Fe) material from being oxidized, a layer of chromium (Cr) is coated (as shown in the diagram below). Suppose the oxidation follows Wagner's parabolic model, and the oxidation rate constant (K) for Cr and Fe is respectively $2.5 \times 10^{-8} \text{ cm}^2/\text{sec}$ and $2 \times 10^{-6} \text{ cm}^2/\text{sec}$. It is assumed that the oxidation rate constant of iron under chromium oxide coating remains the same as it is in direct contact with air. Determine what is the minimum thickness of Cr coating is needed to protect Fe for 5 years (365 days per year) from oxidation up to a maximum thickness of 2 cm (i.e., the maximum thickness of Fe oxidation to be allowed is 2 cm)?

It is assumed that the molar volume (and thus the thickness) of metal and metal oxide remain the same.

Hint: coating of Cr will be oxidized (sacrificed) completely first before the Fe metal underneath undergoes oxidation to form its own oxide layer.

