This Week's Citation Classic

Kelly E J. The active iron electrode. I. Iron dissolution and hydrogen evolution reactions in acidic sulfate solutions. *J. Electrochem. Soc.* **112**:124-31, 1965.*
[Chemistry Division, Oak Ridge Natl. Lab., Oak Ridge, TN]

The results of this electrochemical study of zone-refined iron in H_2-saturated acidic sulfate solutions serve to resolve the conflicts concerning the mechanisms of iron dissolution and hydrogen evolution in noninhibiting media. [The *SCI*® indicates that this paper has been cited in over 120 publications since 1965.]

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December 7, 1982

"In the early-1960s, as a member of the small 'Electrode Kinetics and Corrosion' group at the Oak Ridge National Laboratory, I found myself investigating the electrochemical behavior of iron (my 'model' metal) in aqueous benzoate solutions. The tentative object of the work was to determine the detailed mechanism of corrosion inhibition by the benzoate anion, my 'model' adsorption inhibitor. Eventually, it became only too evident that one would first have to understand the mechanisms of iron dissolution and hydrogen evolution on iron in the absence of the inhibitor and, consequently, I began the study described in the paper under discussion. At the time, previous research on the electrochemical and corrosion behavior of iron had culminated in the truly classic works of Heusler[1] and, somewhat later, Bockris *et al.*[2] Unfortunately, neither the reaction mechanisms nor the underlying experimental data presented by these investigators were in agreement. My own results substantiated the findings of the Bockris school, leading many to refer to the mechanism of iron dissolution in acidic media as the Bockris-Kelly mechanism. The mechanism for the uninhibited sulfate system then served as the basis for analyzing the more complex electrochemical behavior of iron in the inhibited benzoate system.[3] Moreover, it was suggested in my paper that metals such as cobalt should exhibit the same dissolution mechanism found for iron, a projection later confirmed by others.[4] The mechanism for iron dissolution has also served as a model for the more complex behavior of certain metals such as titanium.[5]

"What reason can I give for the citation frequency of my paper? In retrospect, I believe that my paper on iron, together with those of Heusler and Bockris *et al.*, represented a textbook example of the application of electrode kinetics to an actively corroding metal. Collectively, our work served to stimulate a great deal of activity in the field of metallic corrosion and, consequently, achieved a high citation rate.

"In the brief space that remains, I should like to inject a personal note. We are all aware of the fact that an individual researcher may find himself evaluated, supported, and rewarded on the basis of the *number* of his publications per year, not on the quality or importance thereof. Now, I fear, those who resort to this approach to the evaluation of scientists and their work have embraced a new 'quantitative' measure of value, the citation rate, i.e., the number of citations per man year. This is not the place to point out the obvious flaws in this practice, but I should like to know how many citations a *Citation Classic* is worth? My computations suggest 1984."

1. **Heusler K E.** Der Einfluss der Wasserstoffionen konzentration auf das electrochemische Verhalten des aktiven Eisens in sauren Losungen. Der Mechanismus der Reaktion $Fe \rightleftarrows Fe^{++} + 2e$. *Z. Elektrochem.* **62**:582-7, 1958.
2. **Bockris J O'M, Drazic D & Despic A R.** The electrode kinetics of the deposition and dissolution of iron. *Electrochim. Acta* **4**:325-61, 1961.
3. **Kelly E J.** The active iron electrode. II. Anion adsorption and its effects on the iron dissolution and hydrogen evolution reactions. *J. Electrochem. Soc.* **115**:1111-19, 1968.
4. **Tikkanen M H & Tuominen T.** On the anodic behaviour of cobalt. *Proceedings of the Third International Congress on Metallic Corrosion, Moscow, 1966.* Moscow: MIR Publishers, 1969. Vol. 1. p. 489-500.
5. **Kelly E J.** Electrochemical behavior of titanium. (Bockris J O'M, Conway B E & White R E, eds.) *Modern aspects of electrochemistry.* New York: Plenum Press, 1982. Vol. 14. p. 319-424.

*Research sponsored by the Division of Material Sciences, US Department of Energy under contract W-7405-eng-26 with the Union Carbide Corporation.