Classification of bursting activity during iron electrodissolution in sulfuric acid in the presence of halide ions

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The electrodissolution of iron in sulfuric acid is accompanied by current oscillations under potensiostatic conditions. These oscillations are monoperiodic and of relaxation type and are observed near the potential region where the active to passive state transition of the iron electrode takes place [1]. If a small amount of halide ions is added to the electrolytic solution the system's response under the same potensiostatic conditions alters drastically. In this case the amount of the passivated electrode area is significantly reduced due to the effect of pitting corrosion. The above monoperiodic oscillations cease giving their place to new ones of bursting type. This type of dynamic response is widely observed in various neural cells systems under similar conditions and thus it's study could lead to models that interpret the neuronal response [2, 3].

The aim of the present work is to associate the dynamic response with the characteristics of the iron interface during electrodissolution in sulfuric acid in the presence of halide ions. Two types of experiments are performed: (a) starting from an active (free) iron surface the electrode interface is stimulated towards the anodic direction via a potential step and the temporal current response is recorded; (b) starting from a passive iron surface - resulted via pitting corrosion - the interface is stimulated by stepping or scanning the potential towards the anodic direction and the temporal current response is recorded. The temporal evolution is classified by measuring the firing rate and determining the bursting characteristics. Two types of bursting activity have been observed. The first one, Fig 1a, takes place at relatively low potentials close to the active to passive transition region while the second, Fig 1b, which has not been reported before, occurs at high potential values. A comparison is made between the different classes of temporal activity and different types of bursting are associated with the interface condition.

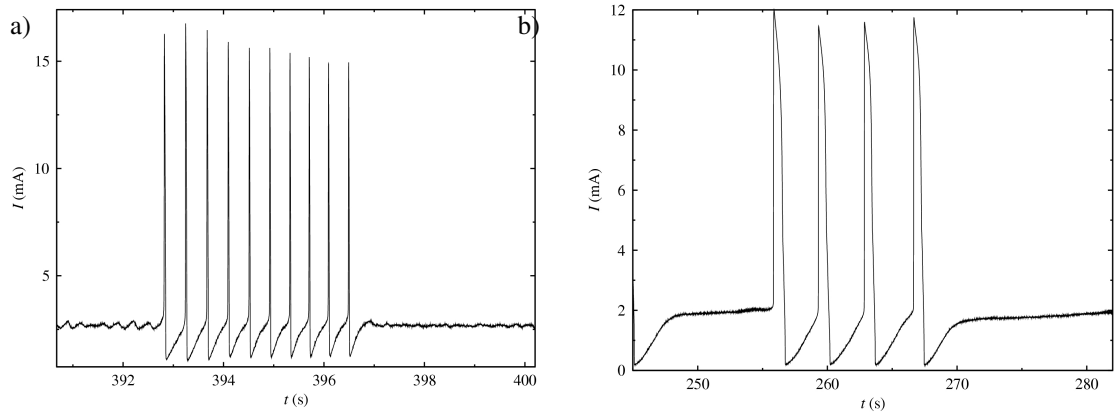

Fig1. Bursting oscillations at a) low and b) high potential values

[1] D. Sazou, A. Karantonis, M. Pagitsas, Int. J. Bifurc. Chaos **3**: 981 (1993)
[2] M. Pagitsas, A. Diamantopoulou, D. Sazou, Electrochim. Acta **47**: 4163 (2002)
[3] D. E. Postnov, O. V. Sosnovtseva, S. Y. Malova, E. Mesokilde, Phys. Rev. E **67**:016215 (2003)