

Recent Advances in Understanding the Critical Pitting Temperature

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Abstract The critical pitting temperature (CPT) represents a critical condition for stable pit growth and is used as a principal parameter to evaluate the pitting resistance of stainless steels and nickel-based alloys. In the past several decades, many efforts have been made to clarify the underlying mechanism behind the CPT phenomenon. In this talk, we will summarize our existing understanding on this topic based on a recent framework for pit growth stability [1-3]. However, the previous theory mainly focused on the potentiostatic-CPT, which is associated with a sharp increase in current caused by pitting when the temperature increases above the CPT. Although many new insights were generated, the framework cannot fully rationalize the potentiodynamic-CPT, which is the sharp transition of breakdown potential from the transpassive region to pitting region when the CPT is exceeded.

To fill the knowledge gap, we proposed that the CPT transition might be related to repassivation underneath the salt film of metastable pits. Our previous work has already confirmed the phenomenon of repassivation underneath the salt film in deep pits (~400 μm) [4]. We expected that this phenomenon also occurs in metastable pits (i.e. small pits) but it has not yet been reported. To verify this hypothesis, the critical conditions of potential (E) and temperature (T) for repassivation at relatively small depth (20 μm and 30 μm) were investigated using one-dimensional artificial pit electrodes. The repassivation underneath the salt film in small pits was indeed observed. Based on this finding, several possible models were proposed to interpret the potentiodynamic-CPT, and insights for a more comprehensive understanding on pit growth stability were also generated.

Keywords pit growth stability; salt film; repassivation temperature; critical pitting temperature; one-dimensional artificial pit electrode

Reference

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