Multiscale Entropy Analysis of Electrochemical Noise

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A multiscale entropy (MSE) method is introduced to the analysis of electrochemical noise (EN) signals. Compared with other time domain, frequency domain and time-frequency domain methods, MSE can precisely provide quantitative information about the randomness and complexity of EN signals in multiple time scales. Analysis of simulated signals with different parameters indicate that complexity of EN signals increases with the number of pitting events and noise level, and not affected by the amplitude characteristics. EN signals with typical transient shapes for pitting corrosion in aerated solutions exhibit distinct entropy characteristics, compared with other transient shapes. Variation of entropy values over different time scales makes it necessary to use multiscale analysis of the complexity and randomness of EN signals. Results on experimental signals indicate that MSE analysis is useful in classifying different corrosion types. The MSE curves for several different EN signals from literatures are compared. Both simulated and experimental signals demonstrate that entropy analysis on a single time scale is not reliable and may lead to misleading results.

Keywords: Multiscale; entropy; electrochemical noise; time series; corrosion.

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