Dissolution/Deposition of Zinc in the Deionized Water (60 < T (°C) < 93.3)

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Abstract

The release rate of zinc (Zn) in the deionized (DI) water has been measured over at temperatures, 60, 71.1, 82.2 and 93.3°C for the exposed times between of 24 and 74 hrs, which provided continuous in situ measurement of dissolved zinc vs. time. Total dissolved zinc content in the test DI-water was analyzed by inductively coupled plasma (ICP) spectrometers. The direction of approach to the time dependent dissolved concentration towards the equilibrium saturation state was archived to evaluate the release rate versus time. In order to address the status on the system progress, extensively performed by adapting the best reprehensive thermodynamic analysis on the zinc dissolution. A least-squares regression of the results obtained to fit the released rate zinc vs. time to establish the formula for the zinc releases in the in the DI-water as,

$$\text{Log}\,[RR_{Zn}(T, t)] = -3.5873 + 0.026365*T + 0.4504*t - 0.008276*T*t,$$

where RR_{Zn} in [mg- Zn/cm^2-hr], and T in [°C], and t in [hr].

The rate determining step for the zinc release rates in the DI-water were well recognized based on the zinc ion chemical diffusion. The disappearing of dissolved zinc from the DI-water also the rate determined by the chemical diffusion, too, because the disappearing of dissolved zinc from the DI-water is able to react with the outward positive zinc ion, such as Zn^{+2} react with negative zinc ion, such as dissolved $Zn(OH)_3^-$ as for the deposition is proposed. The SEM view for the tested zinc sample surface indicated, much higher degrees of ZnO-$Zn(OH)_2$ scale layer has been formed (5-10 μm thick) compare with the max dissolution of 0.054-μm thickness calculated by the dissolved zinc. This assessment supports well to the chemical diffusion with thickening scale layer for the time and temperature dependent dissolution/deposition along with the chemical thermodynamic evaluations.

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