AC Impedance Responses of the Inconel 718 Alloy During Electropolishing in Perchloric-Acetic Mixed Acids

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The electropolishing behavior of Inconel 718 alloy was studied with an alternating current (AC) impedance test at 25°C in perchloric-acetic mixed acids with different HClO₄ contents. The AC impedance test was conducted by polarizing a potential located in the limiting-current plateau with four potential amplitudes of 20, 200, 500, and 1000 mV. Experimental results show that the electropolishing behavior of Inconel 718 alloy depends strongly on the HClO₄ content in the mixed acids. Leveling and brightening of the surface was obtained when Inconel 718 was polished in mixed acids with 30 and 40 volume percents of HClO₄, while leveling without brightening of the surface is achieved when Inconel 718 was polished in mixed acids with 10 and 20 vol% HClO₄. The electropolishing behavior of Inconel 718 alloy in mixed acids can be recognized from its AC impedance response. Based on the results of AC impedance test, the electropolishing mechanism of Inconel 718 in the mixed acids follows the salt-film precipitated mechanism. A high potential amplitude from 200 to 500 mV is recommended for obtaining a stable AC impedance response based on our experimental results, those contrast the generally accepted potential amplitudes lower than 20 mV used in the AC impedance test. Differences in stable and unstable AC impedance responses with respect to the potential amplitude are discussed in this study.

Keywords: Inconel 718 alloy, electropolishing, AC impedance test, potential amplitude

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