Selective Etching of Phases and Structural Components in Duplex Stainless Steels"

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Microstructural complexity and constantly growing commercial importance of duplex stainless steels caused considerable development of many etching techniques to reveal general structure and distinction of each phases. Electrolytical technique assures selective etching of phases using the same solution of electrolyte only by changing the applied potential of electrolysis, what acts these methods preferential to conventional chemical methods of revealing microstructure.

With purpose to preferential color etch of ferrite in duplex stainless steels, 20% NaOH and 10 N KOH aqueous solutions were used. In case of samples without heat treatment, it has been found that sufficient revealing of microstructure was taking place at comparatively short times of etching (20% NaOH: 3 V, > 3 s; 10 N KOH: 2-5 V, > 5 s). Besides at enough long times of etching, revealing of grain boundaries in the ferrite phase was also possible (20% NaOH: 3 V, > 90 s; 10 N KOH: 5 V, > 30 s). Electrolytical etching in hydroxide solutions may also be used to reveal sigma phase in 2205 duplex stainless steel microstructure. Particularly useful in revealing grain boundaries were acidic reagents. The best results in revealing grain boundaries using 60%HNO₃/40%H₂O was obtained at relatively short times of etching (5 V, 5 s; 10 V, 1-3 s). Very similar results have been obtained using aqueous 10% oxalic acid, at 3 V potential of electrolysis, optimum circumstances of etching process have been found for times 20-90 s. The electrolytic 5% H₂SO₄ etch revealed grain boundaries fully and uniformly without bringing up the annealing twins.