Examples of Duplex Stainless Steels

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Ferrite-austenite grain structure of hot-rolled and annealed 7-Mo PLUS duplex stainless steel revealed using (left) 15% HCl in ethanol and (right) 10% CrO$_3$ in water, 6 V dc, 10 s.
Ferrite in 7-Mo PLUS colored using aqueous 20% NaOH, 3 V dc, 10 s.
Microstructure of 7-Mo PLUS duplex stainless steel etched with Beraha’s reagent (15 mL HCl – 85 mL water – 1 g K$_2$S$_2$O$_5$). Original at 200X. Ferrite is colored and austenite is unaffected.
Microstructure of 7-Mo PLUS duplex stainless steel etched with aqueous 20% NaOH (3 V dc, 5 secs) which colors the ferritic matrix blue and the austenitic particles a light yellow (normally not colored). Hot working direction is vertical. Austenite: 362 HK; ferrite: 264 HK hardness. Original at 500X.
Microstructure of 2205 duplex stainless steel in the solution annealed condition. Etched with aqueous 20% NaOH, 3 V dc, 12 sec. To color the ferrite. Austenite is white.
Ferrite colored in 2205 solution annealed at 1200 °C revealed using 20% NaOH, 3 V dc, 10 s.
UNS 32760 Super Duplex Stainless Steel
Sigmatized

Etched with 10% Oxalic Acid, 6 V dc, 10 s
CD-4MCu

Fe - <0.04% C – 25.8% Cr – 5.4% Ni – 2% Mo – 3% Cu

Duplex structure of cast CD-4MCu stainless steel (295 HV); waterless Kalling’s reagent.
Microstructure of as-cast ASTM A 890-5A duplex stainless steel in the solution annealed condition. Etched with aqueous 20% NaOH (3 V dc, 10 sec). Original at 100X. Ferrite is colored and austenite is unaffected.
As-Cast ASTM A 890-5A

Microstructure of as-cast ASTM A 890-5A duplex stainless steel in the solution annealed condition. Etched with Murakami’s reagent (80 °C). Original at 100X. Ferrite is colored and austenite is unaffected.
Microstructure of as-cast ASTM A 890-5A duplex stainless steel in the solution annealed condition. Etched with LB1 (100 mL water – 20 g NH₄FHF – 0.5g K₂S₂O₅). Original at 100X. Austenite is colored and ferrite is unaffected. Because it is as-cast, there are no annealing twins in the austenite.
Influence of etch composition on etch time at 100 °C with standard Murakami’s (left) and modified Murakami’s (right) to reveal the ferrite phase.
Etching for only 10 s at 100 °C with this version of modified Murakami’s reagent colored the ferrite in only 10 s.
As-Cast ASTM A 890-4A

Fe - <0.03% C – 22.25% Cr – 5.5% Ni – 3% Mo – <1% Cu – 0.2% N

Ferrite colored in ASTM A 890-4A using (left) 20% NaOH, 3 V dc, 10 s and (right) with Murakami’s, boiling 100 °C, 120 s.
As-cast CD3MN duplex stainless steel aged 30 days at 800 °C after etching with Murakami’s reagent for 40 s at 90 °C to color the ferrite tan. Austenite is white. The intermetallic phases are sigma and (perhaps) chi phases.
Cast CD7MCuN Duplex Stainless Steel

Modified (30-30-100) Murakami’s – 10 s at 90-100 °C