Analysis of Precipitates: AlN, M\textsubscript{23}C\textsubscript{6}

Hot rolled strip of Fe–16Cr–0.5Mn–0.1Ni–0.1Al–0.07C–0.03N (mass-%) ferritic stainless steel

**AlN**: $P6_3mc$, $a=0.311$ nm, $c=0.498$ nm

**M\textsubscript{23}C\textsubscript{6}**: $Fm\bar{3}m$, $a=1.05$ nm

Analysis of Precipitates: Twinned $M_{23}C_6$

Twinned $M_{23}C_6$ precipitates in a 16%Cr ferritic stainless steel

Analysis of Precipitates: AlN, M$_{23}$C$_6$

STEM images and EDS analysis of AlN and M$_{23}$C$_6$ precipitates in a hot rolled strip of Fe–16Cr–0.5Mn–0.1Ni–0.1Al–0.07C–0.03N (mass-%) ferritic stainless steel

Analysis of Precipitates: $M_2N$

$M_2N$ precipitates in a 16%Cr ferritic stainless steel

$M_2N$: $P6_3/mmc$, $a=0.274$ nm, $c=0.444$ nm

Orientation Relationship

$\langle 110 \rangle_{bcc} // \langle 001 \rangle_{hcp}$

$\langle 111 \rangle_{bcc} // \langle 110 \rangle_{hcp}$

Analysis of Precipitates: $\text{M}_2\text{N}$

Elongated $\text{M}_2\text{N}$ precipitates in a 16%Cr ferritic stainless steel

Orientation Relationship

$$(110)_{\text{bcc}} // (001)_{\text{hcp}}$$

$$<111>_{\text{bcc}} // <110>_{\text{hcp}}$$

BF, SAD

Faulted $M_7C_3$ carbides in an Fe–17Cr–6Mn–3Ni–4Al–0.45C duplex stainless steel

Analysis of Precipitates: $M_7C_3$

Space group: pnma
a=4.512, b=6.891, c=12.119 Å

Hexagonal
a=6.969, c=4.463 Å

Analysis of Precipitates: $M_3C$

Orthorhombic $M_3C$ (θ):
- $a = 0.509$ nm
- $b = 0.674$ nm
- $c = 0.452$ nm

SAD pattern of martensite and two cementite (θ) variants

Z.A.: [0-11]$_{\alpha}$/[001]$_{\theta}$/[001]$_{\theta}$

-200$\alpha$
-240$\alpha$
240$\alpha$
200$\alpha$
-200$\alpha$
200$\alpha$
020$\alpha$
220$\alpha$
011$\alpha$
-220$\alpha$
-220$\alpha$

Bagaryatski O.R.:
- {112}$_{\alpha}$/ {010}$_{\theta}$
- <01-1>$_{\alpha}$/ <001>$_{\theta}$

Dark field imaging of a tempered Fe–13Cr–0.3C martensitic stainless steel using two different cementite reflections

BF, DF, SAD


Analysis of Precipitates: B2

Fe–17Cr–6Mn–9Ni–7Al–0.46C ferritic stainless steel

B2-(Ni,Fe)Al intermetallics exhibiting a cube-on-cube O.R. with the ferritic matrix

Analysis of Precipitates: VN

**VN** precipitates in an Fe–15Cr–6Mn–3Ni–0.65V–0.5Si–0.11C–0.24N austenitic stainless steel

Recrystallization / Precipitation

TEM montage of **ferrite and Cr carbides and nitrides** in an Fe–16Cr–0.4Mn–0.1Ni–0.04C–0.04N ferritic stainless steel

Annealing time: 30 s + 30 s

Recrystallization / Precipitation

TEM montage of **ferrite and Cr carbides and nitrides** in an Fe–16Cr–0.4Mn–0.1Ni–0.04C–0.04N ferritic stainless steel

**Annealing time: 30 min**

Recrystallization of Martensite and Ferrite

Difference in the recrystallization behavior of ferrite and martensite in a cold-rolled Fe–16Cr–0.4Mn–0.1Ni–0.04C–0.04N ferritic-martensitic stainless steel

Annealing conditions: rapid heating to 750 °C and immediate cooling

BF, DF

Recrystallization of Martensite

**Bulging Recrystallization of $\alpha'$**
Due to the high density of lath boundary precipitates, bulging of recrystallized regions into recovered martensite preferentially occurs in the longitudinal directions of laths.

Fe–16Cr–0.4Mn–0.1Ni–0.04C–0.04N dual-phase stainless steel

**Rex. annealing conditions:**
15 s 830 °C

---

Recrystallization of Martensite

Bulging Recrystallization of $\alpha'$
Due to the high density of lath boundary precipitates, bulging of recrystallized regions into recovered martensite preferentially occurs in the longitudinal directions of laths.

Fe–16Cr–0.4Mn–0.1Ni–0.04C–0.04N dual-phase stainless steel

Rex. annealing conditions:
15 s 830 °C

Stacking Faults

Stabilization of austenite in an Fe–16Cr–0.4Mn–0.1Ni–0.04C–0.04N transformable stainless steel obtained by Q&P processing

J. Mola, B.C. De Cooman, Quenching and partitioning processing of transformable ferritic stainless steels, Scr. Mater. 65 (2011) 834–837.
Deformation-Induced Martensite

α'-martensite formation at intersections of ε-martensite plates in Fe–14.3Cr–5.5Mn–5.5Ni–0.5Si–0.37N–0.02C austenitic stainless steel

Deformation-Induced Martensite

Strain-induced $\gamma \rightarrow \epsilon \rightarrow \alpha'$ transformation route in an Fe–7Mn–0.1C medium Mn steel

Spontaneous Martensite

Fe-15Cr-1Mo-0.3C-0.4N stainless steel after partial transformation to spontaneous (athermal) α'-martensite

Spontaneous Martensite
Fe-15Cr-1Mo-0.3C-0.4N steel after partial transformation to spontaneous (athermal) α′-martensite

Analysis of Precipitates: B2 and σ-Phase

Ferrite + B2-NiAl

σ-phase: tetragonal P4_2/mnm, a=0.880 nm, c=0.4544 nm

SAED, encircled area

BF

DF using the marked B2/σ common spot

Fe–17Cr–6Mn–3Ni–4Al–0.45C duplex stainless steel

BF, DF, SAD

201_α Z.A. // 201_B2 Z.A. // 23-6_σ Z.A.