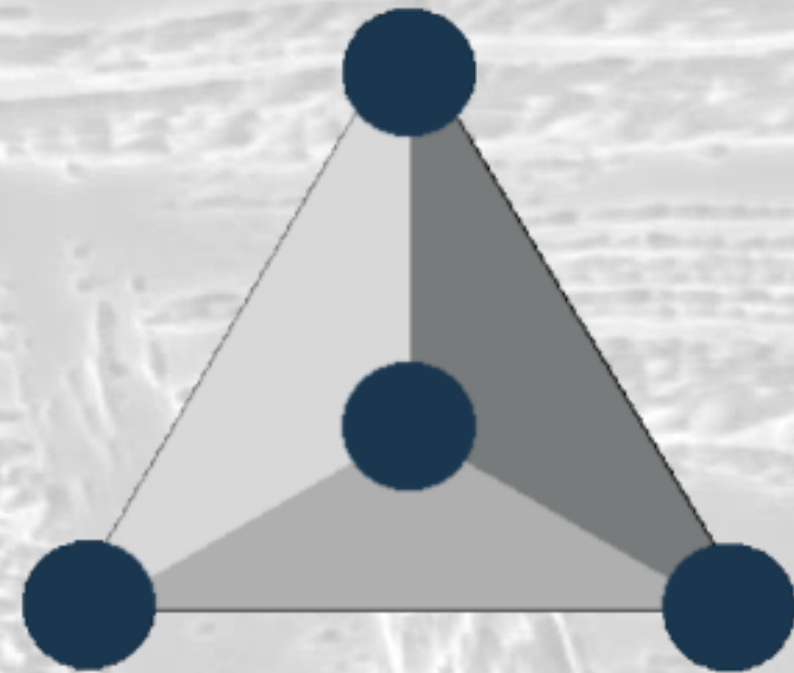


Mertinger Valéria¹, Nagy Erzsébet², Benke Márton¹, Sepsi Máté¹, Kumar Talgotra Arjun¹, Pekker Péter²

Miskolci Egyetem, Fémtani, Képlékenyalakítási és Nanotechnológiai Intézet

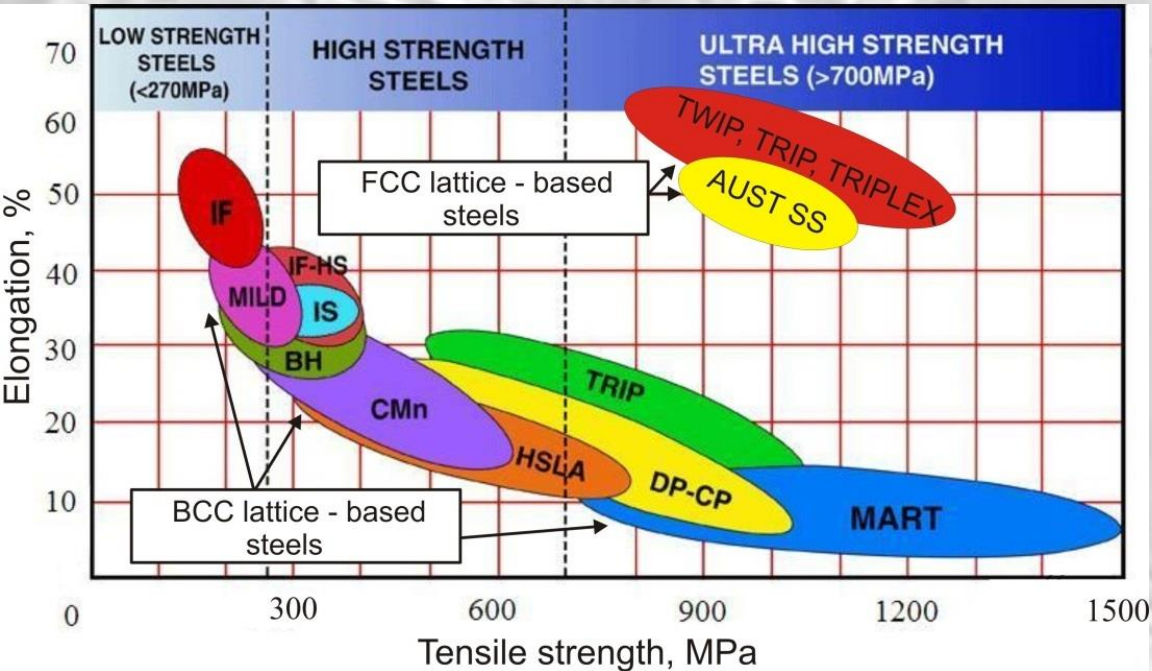
² MTA-ME Anyagtudományi Kutatócsoport

Termomechanikus kezelés hatására végbemenő fázisátalakulások TWIP acélokbán



Fázisátalakulás: Orientáció térképezés

- FEI Tecnai G² TEM and ASTAR
- EBSD - Zeiss EVO MA 10
- Bruker D8 Advance X ray diffraktométer,
- Stresstech G3R központ nélküli diffraktométer



[International Iron & Steel Institute, 2006]

<http://www.boronextrication.com/2017/09/03/tesla-model-3-body-structure/G>

Tesla Model 3

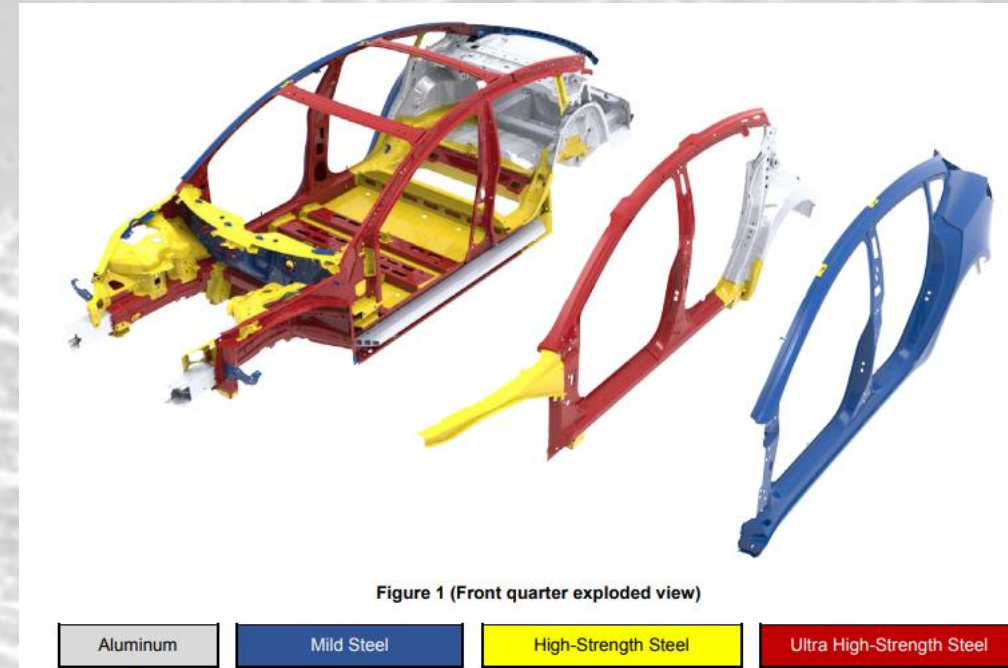
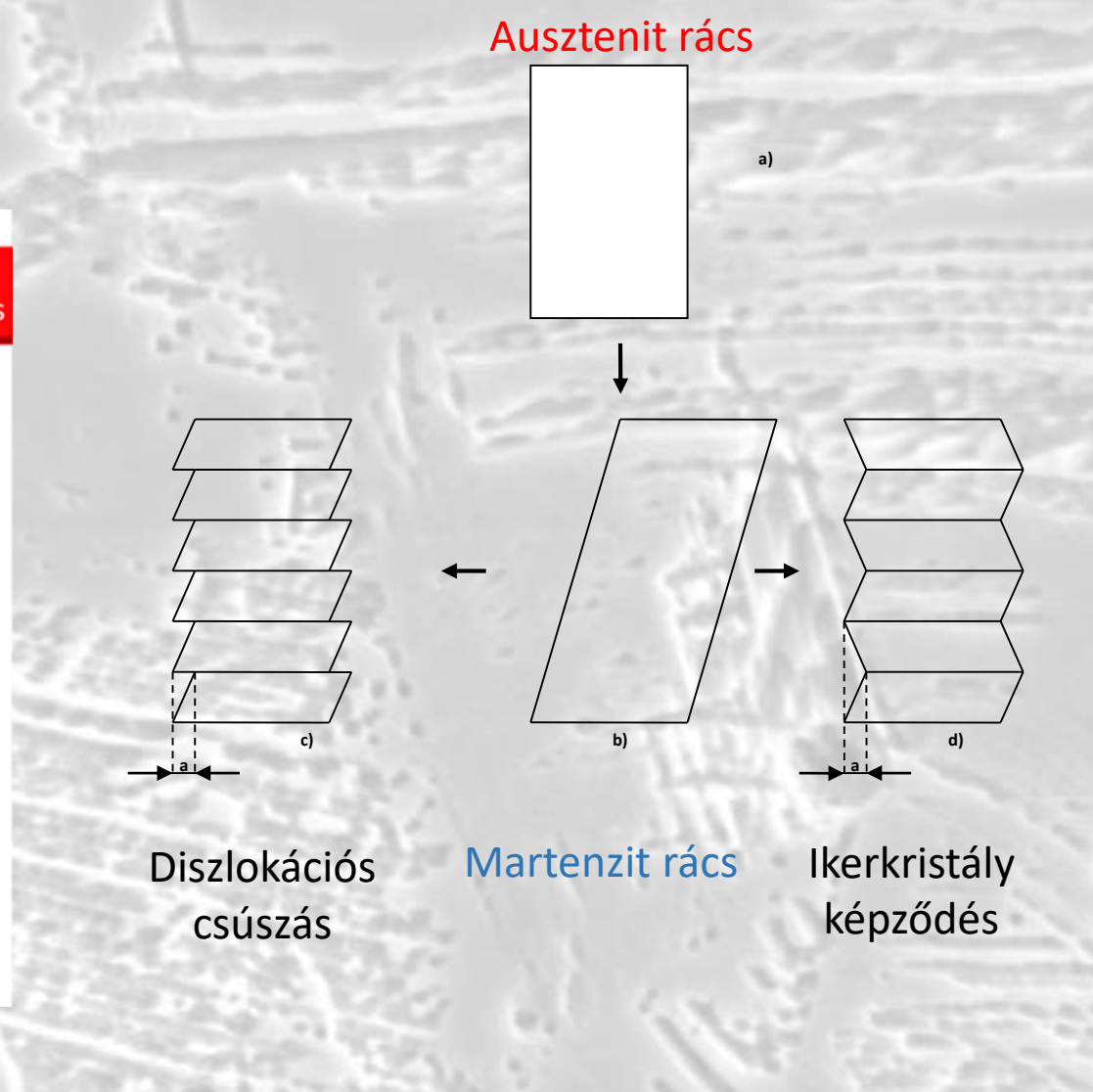
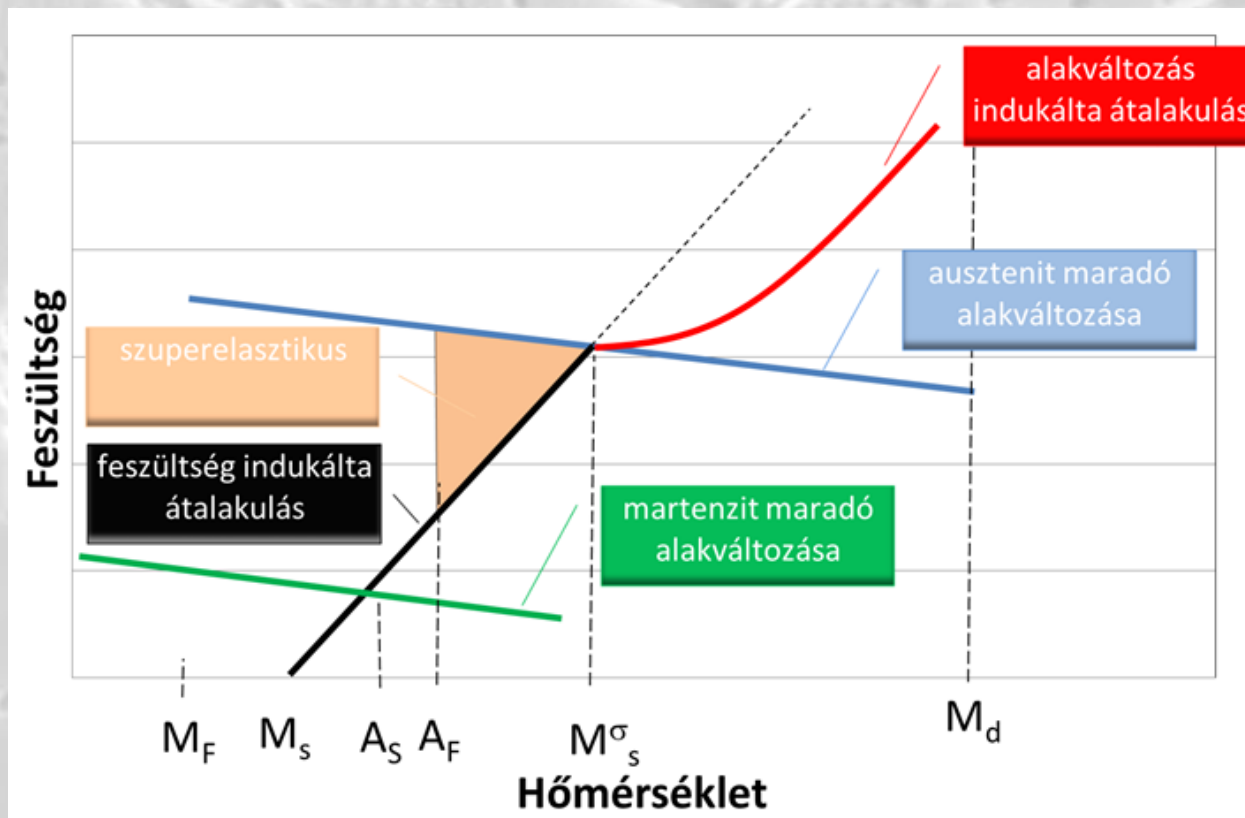


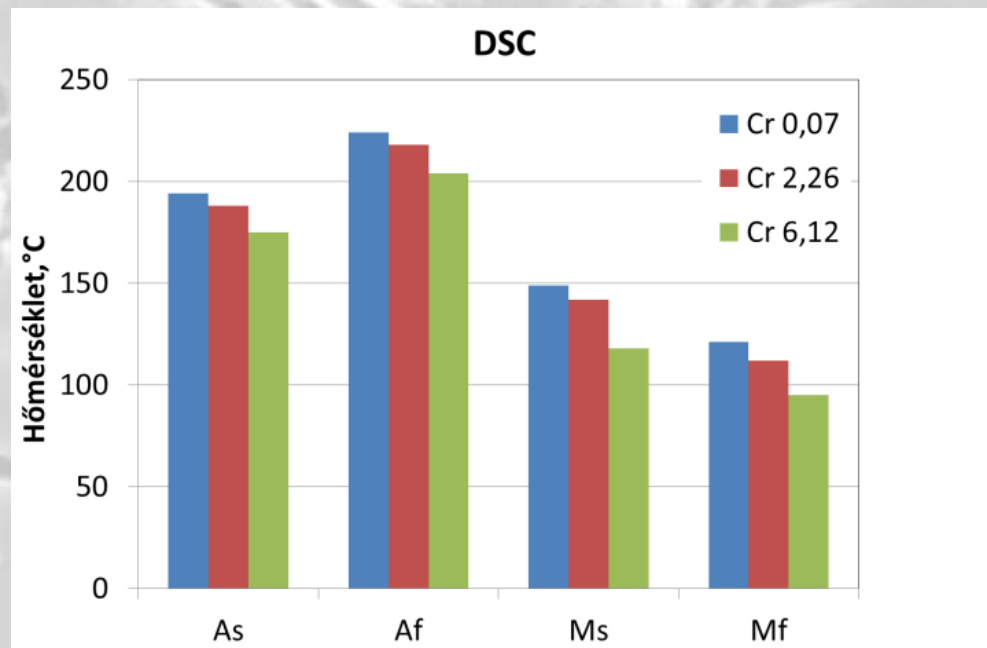
Figure 1 (Front quarter exploded view)

Fázisátalakulások-TWIP acélok



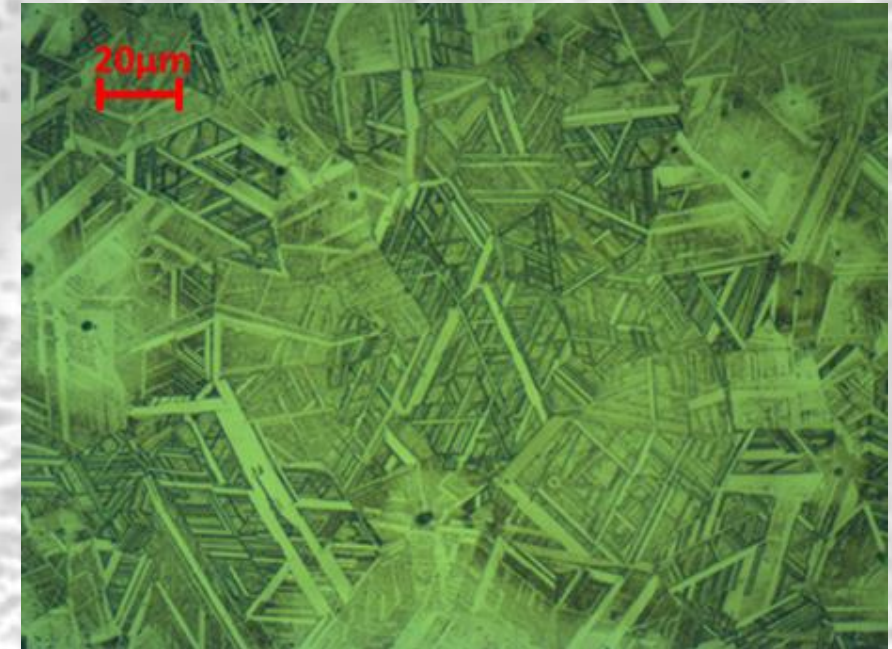
Termomechanikus kezelések
hatására végbemenő folyamatok

	C	Mn	Cr	Si	P	S
acél 2	0,028	18	0,07	0,03	0,0081	0,025
acél 1	0,026	17,7	2,26	0,1	0,0051	0,029
acél 3	0,08	17,7	6,12	0,06	<0,003	0,025



ϵ_T martenzit

edzett



TWIP acélok

Hőntartás
300°C

ausztenit

Hűtés
izotermára

Ha $T > M_s \rightarrow \varepsilon_T$ martenzit

Izoterm
szakítás

Ha $T < M_{d\varepsilon} \rightarrow \varepsilon_d$ martenzit

Ha $T < M_{d\alpha} \rightarrow \alpha$ martenzit

23°C; 110°C; 125°C; 140°C; 160°C;
180°C; 200°C

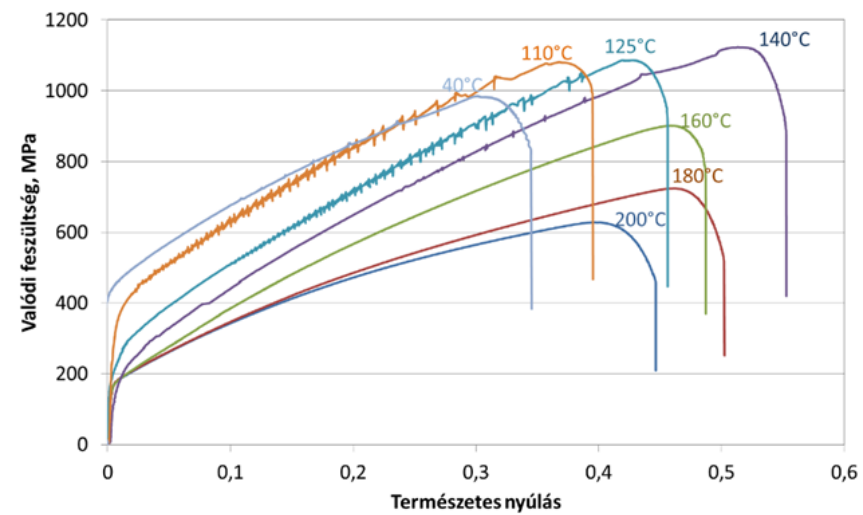
Hűtés
szobahőm.

$\rightarrow (\varepsilon_T \text{ martenzit})$

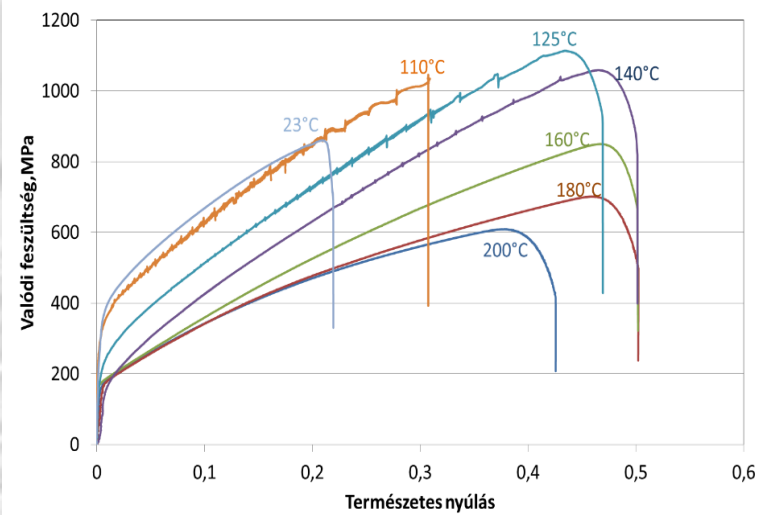


Termomechanikus kezelések
hatására végbemenő folyamatok

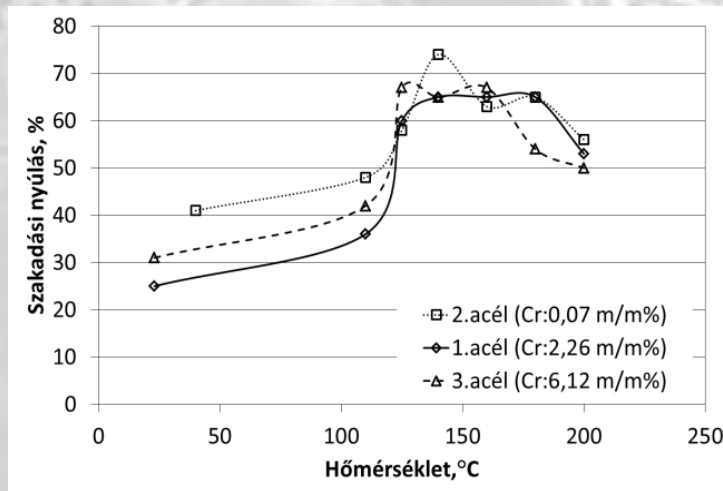
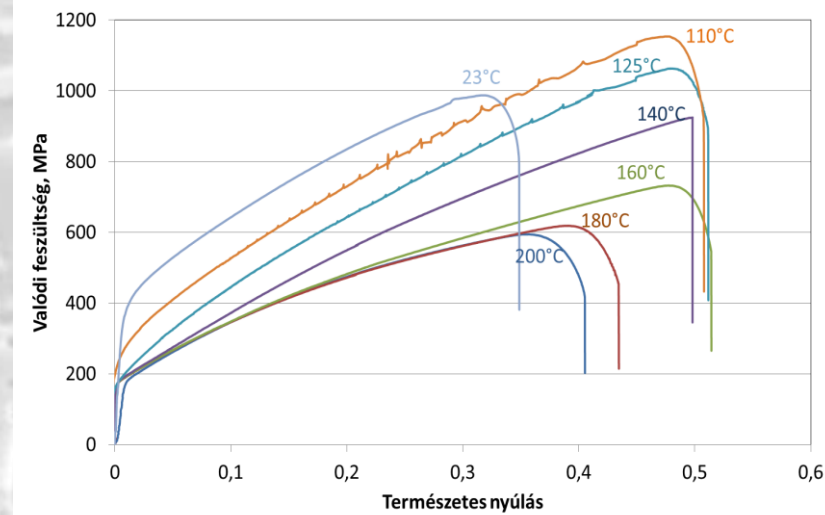
2.acél (Cr:0,07 m/m %)



1.acél (Cr:2,26 m/m %)

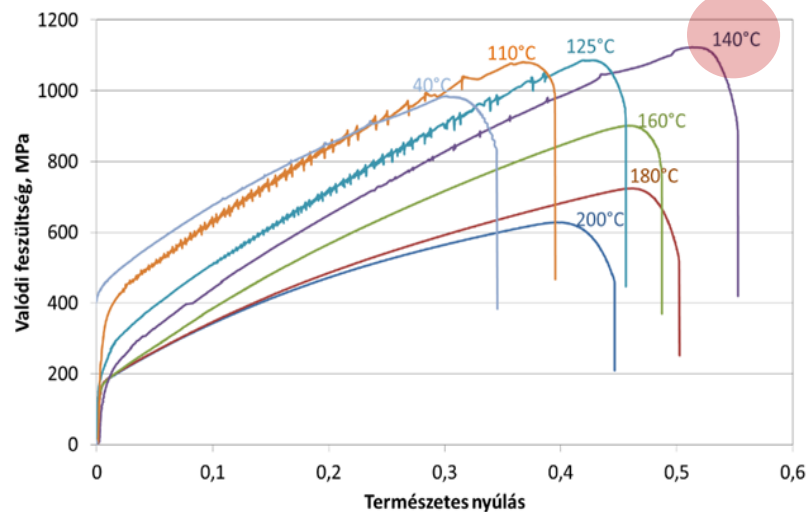


3. acél (Cr:6,12 m/m %)

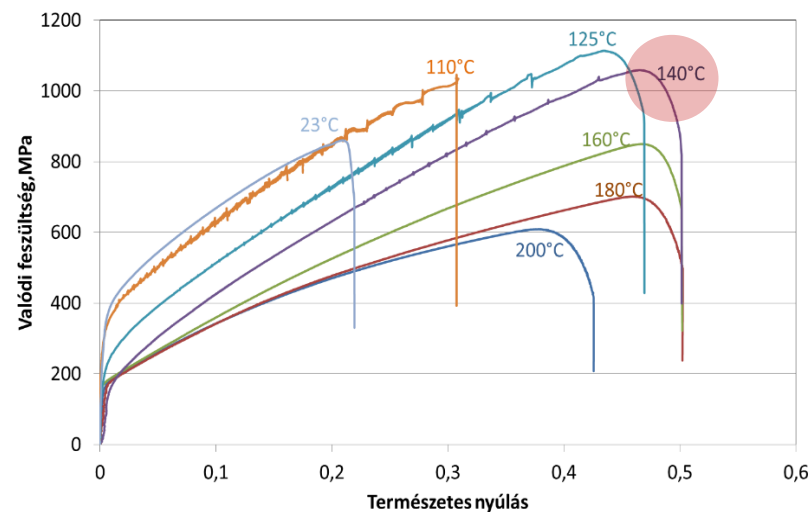


Termomechanikus kezelések
hatására végbemenő folyamatok

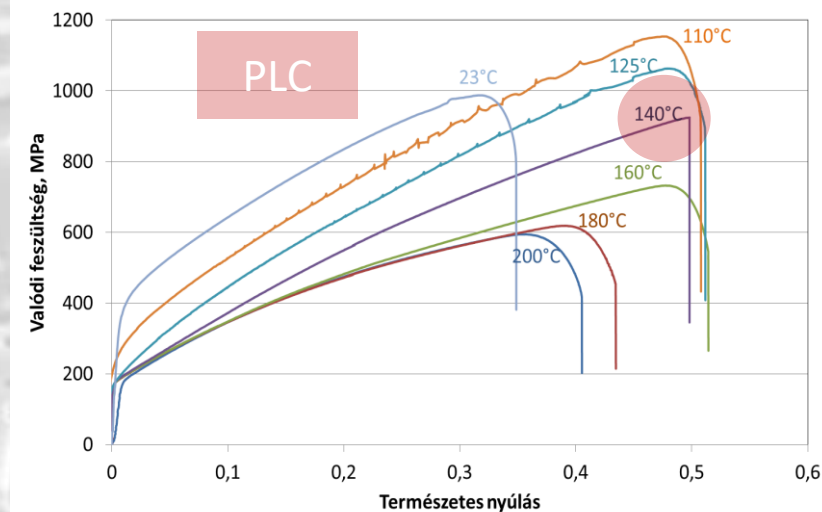
2.acél (Cr:0,07 m/m %)



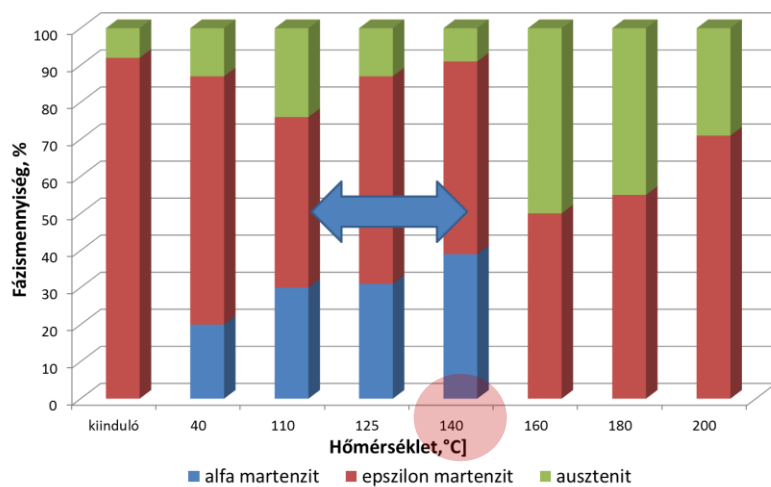
1.acél (Cr:2,26 m/m%)



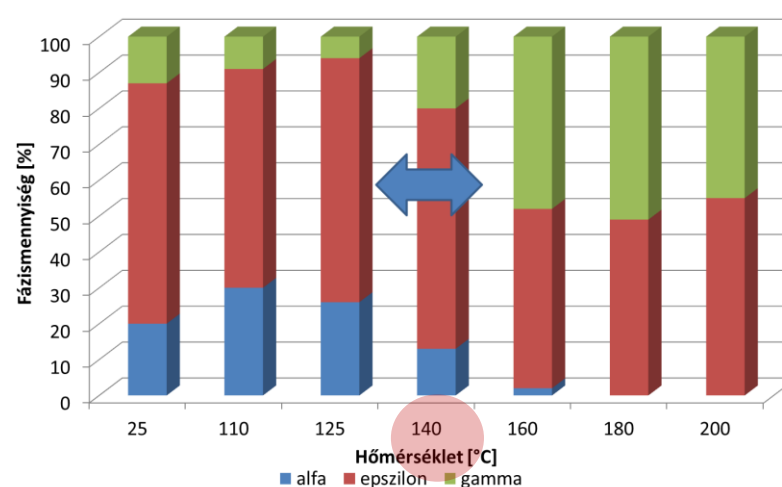
3. acél (Cr:6,12 m/m %)



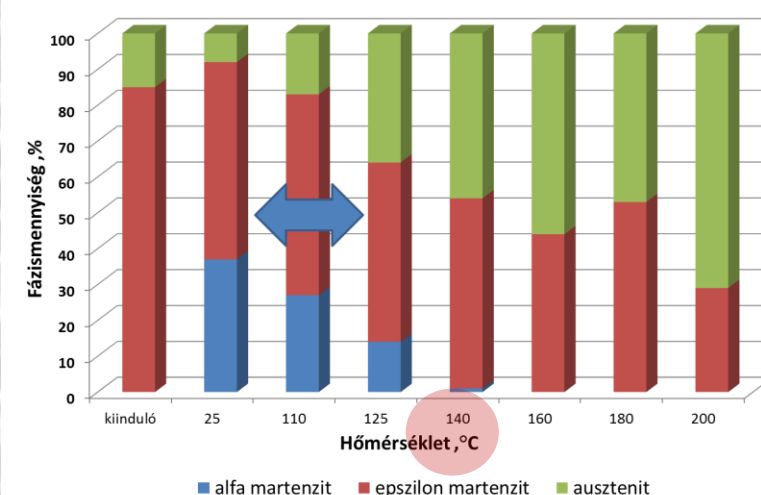
2. acél (Cr: 0.07 m/m%)



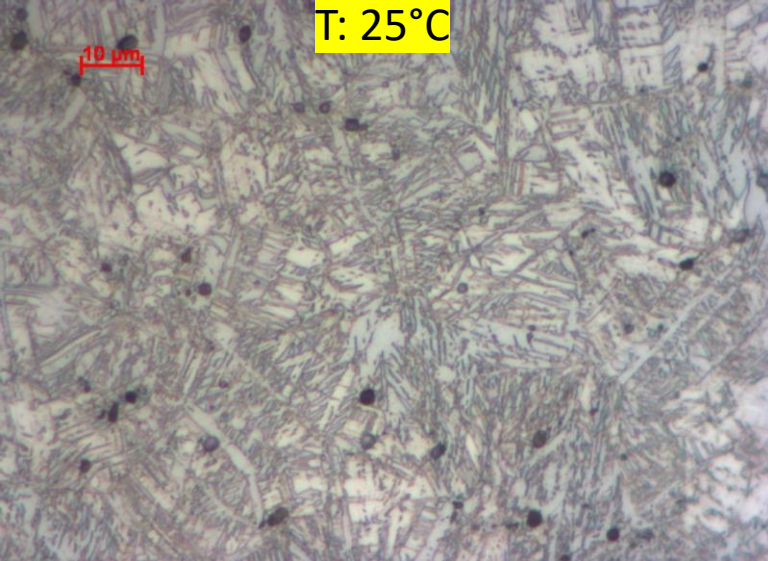
1. acél (2.26%Cr) Keresztmetszet



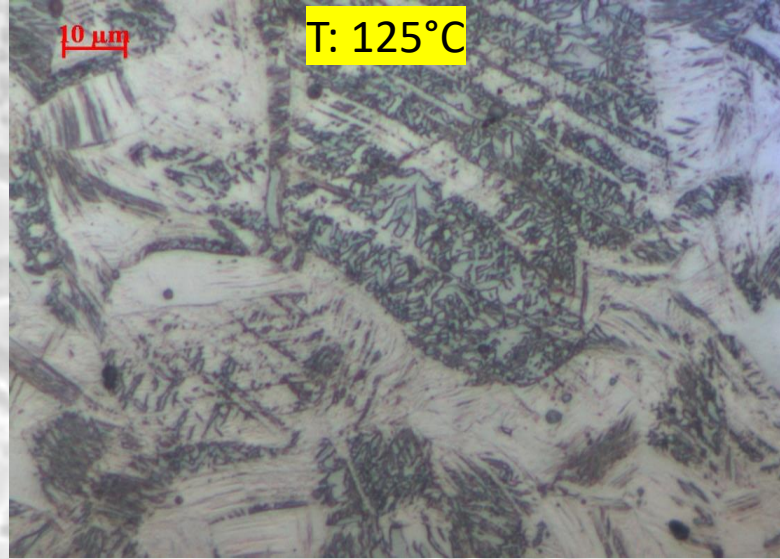
3.acél (Cr:6,12 m/m %)



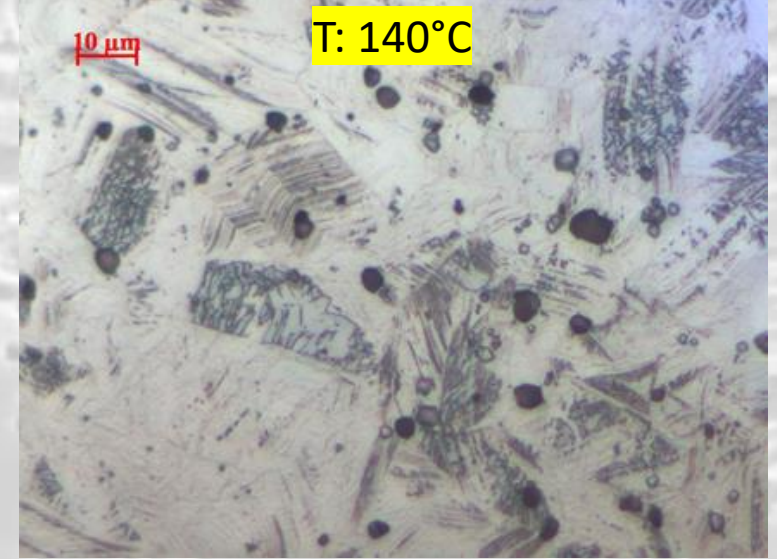
Termomechanikus kezelések hatására végbemenő folyamatok



T: 25°C



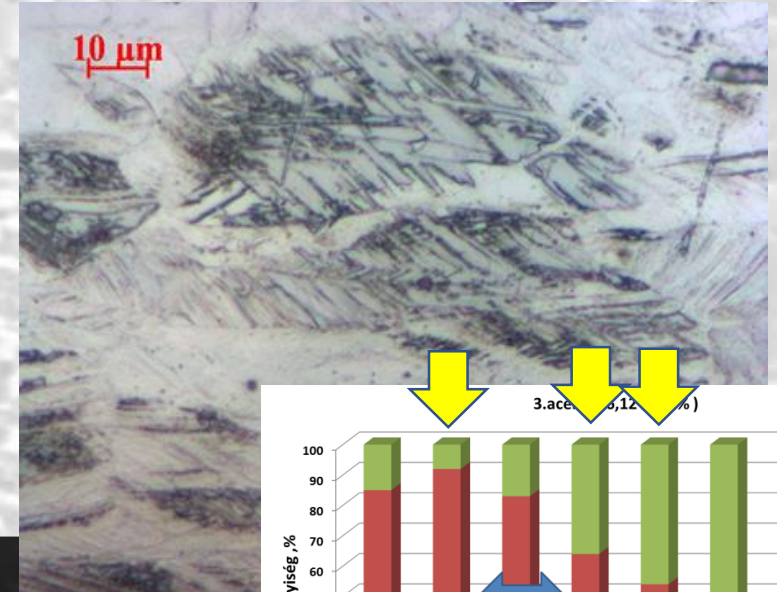
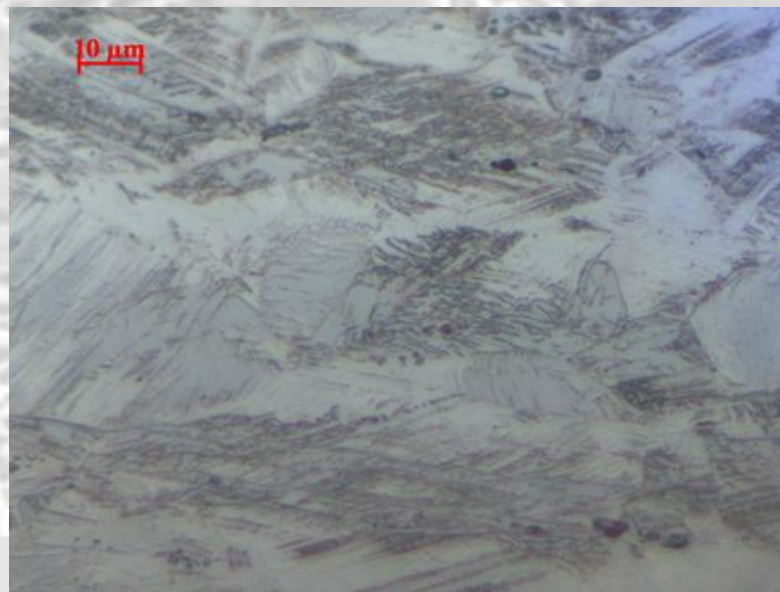
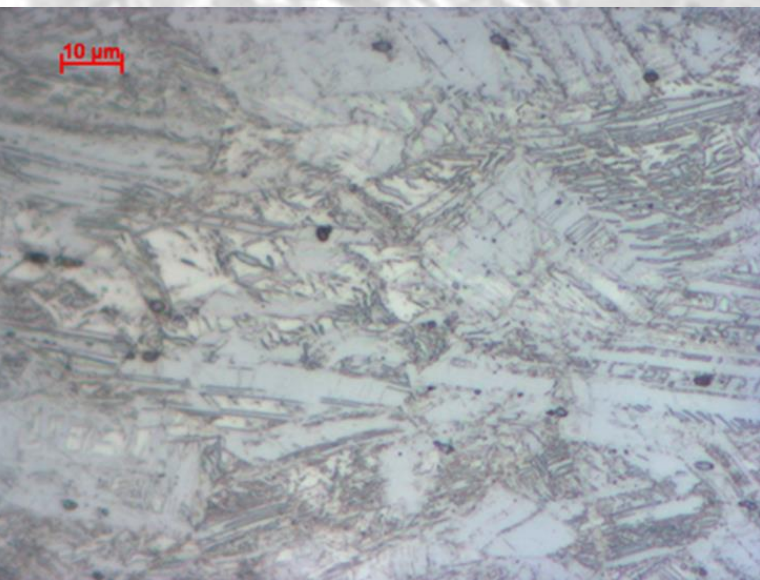
T: 125°C



T: 140°C

Cr 6,12%
Kereszt-
metszet

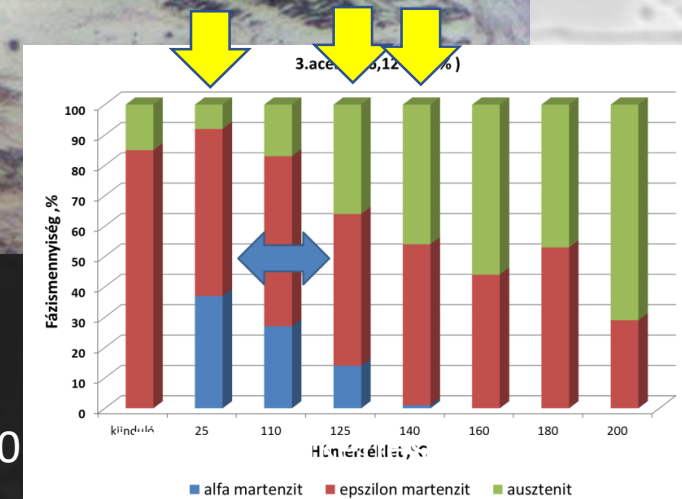
α, γ, ϵ

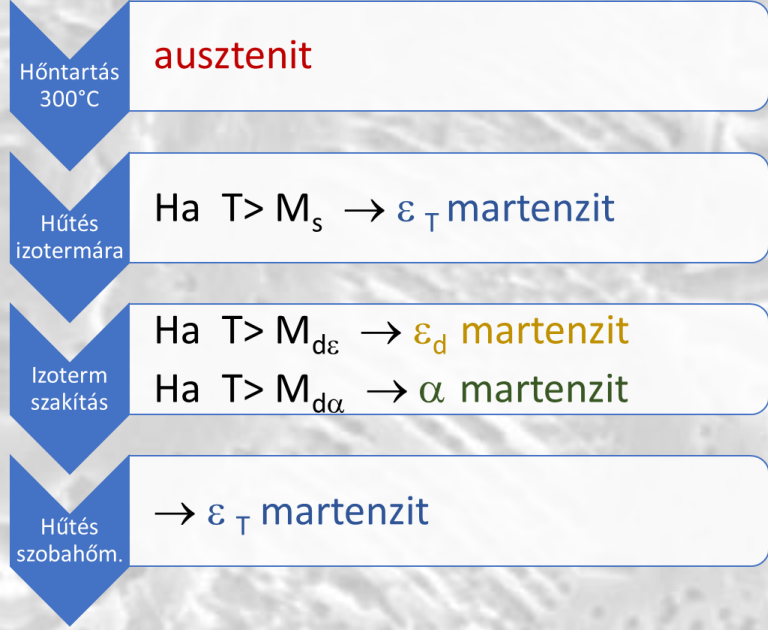


Hossz-
metszet

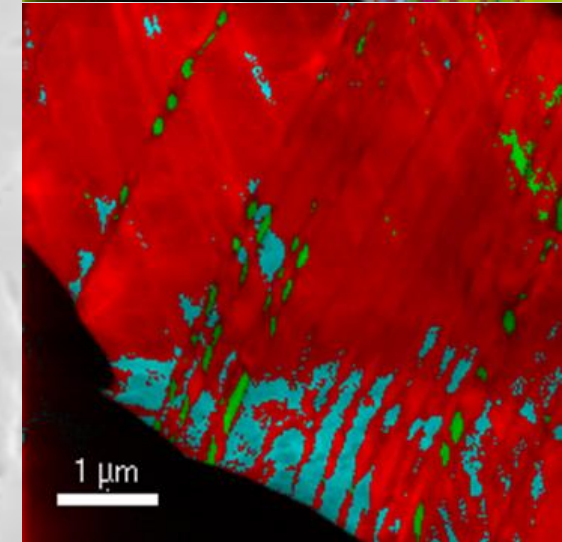
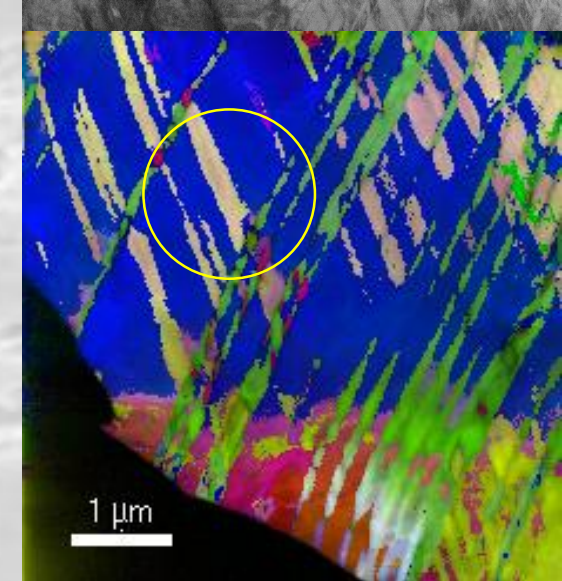
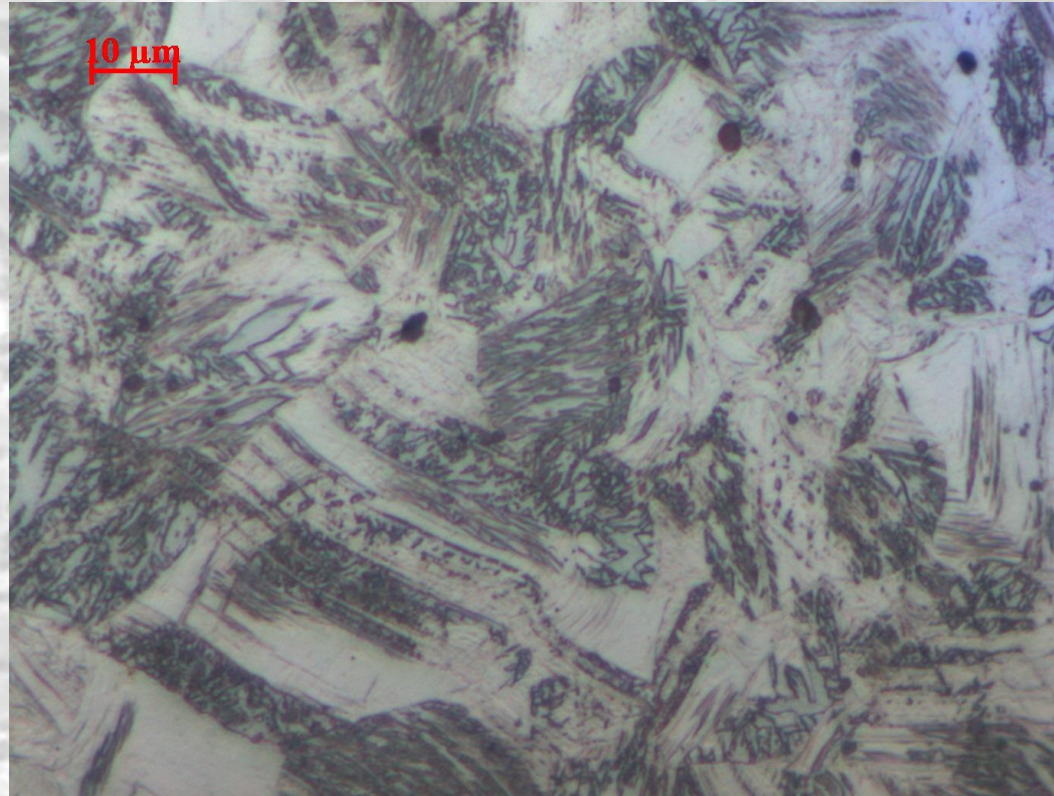
Termomechanikus kezelések
hatására végbemenő folyamatok

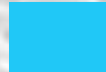
XI. OATK 2017. 10



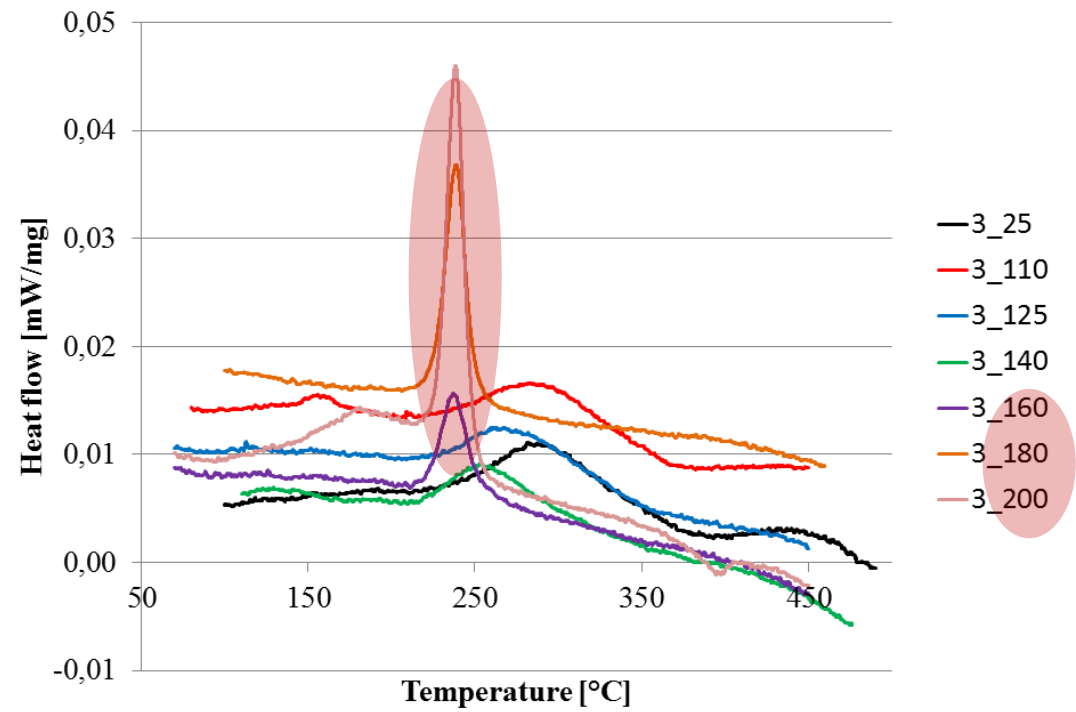
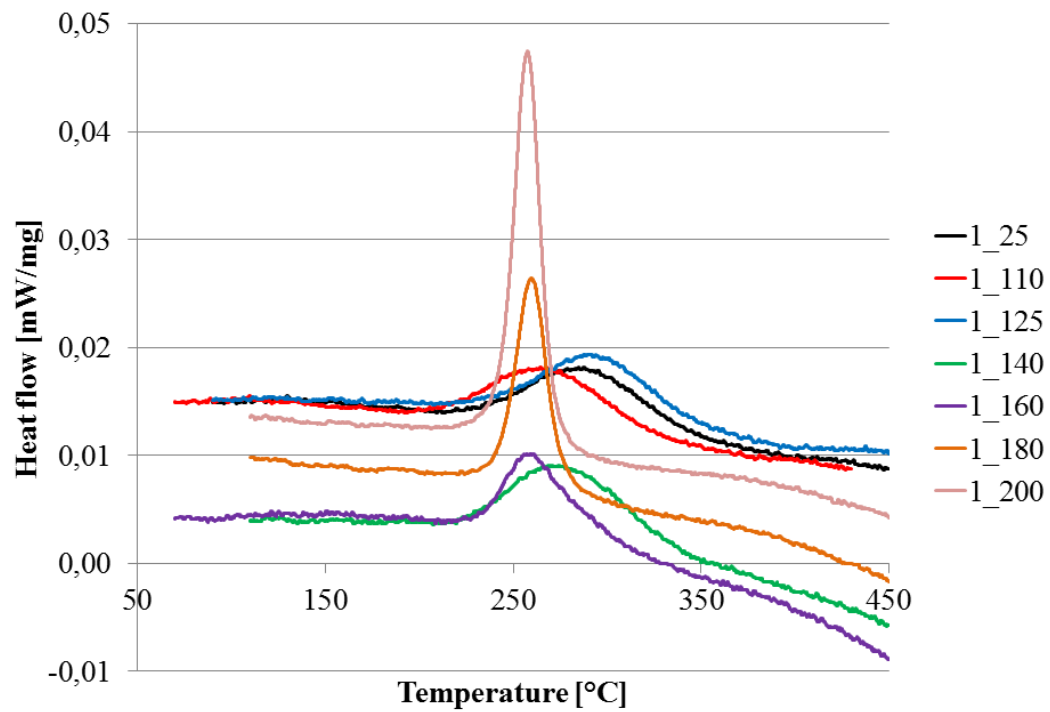


3_125



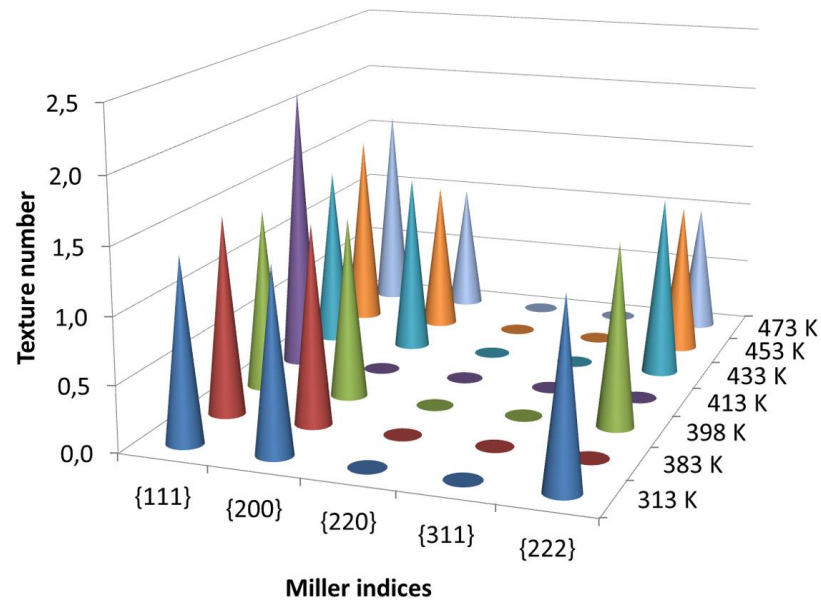
α' :  ε :  γ : 

Termomechanikus kezelések
hatására végbemenő folyamatok

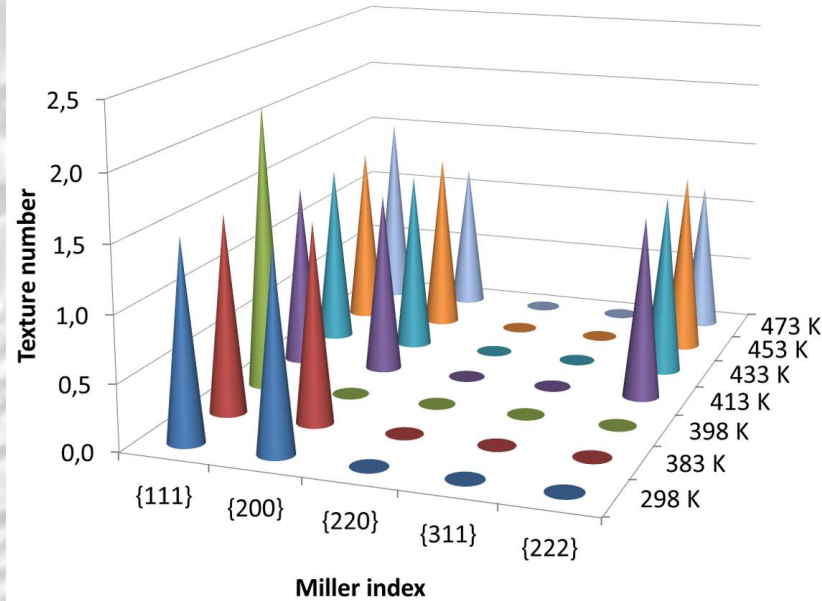


ϵ martenzit bomlása- genetika?

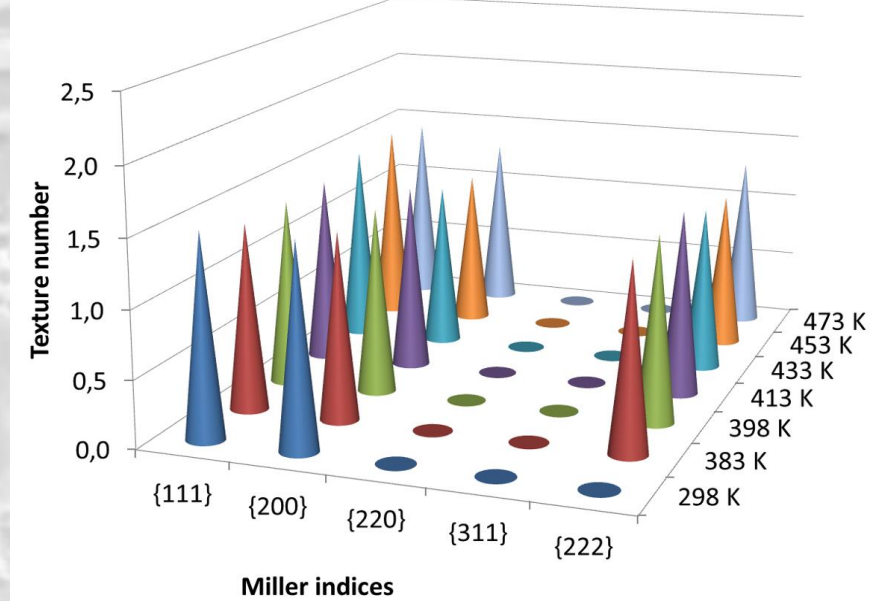
Steel 2



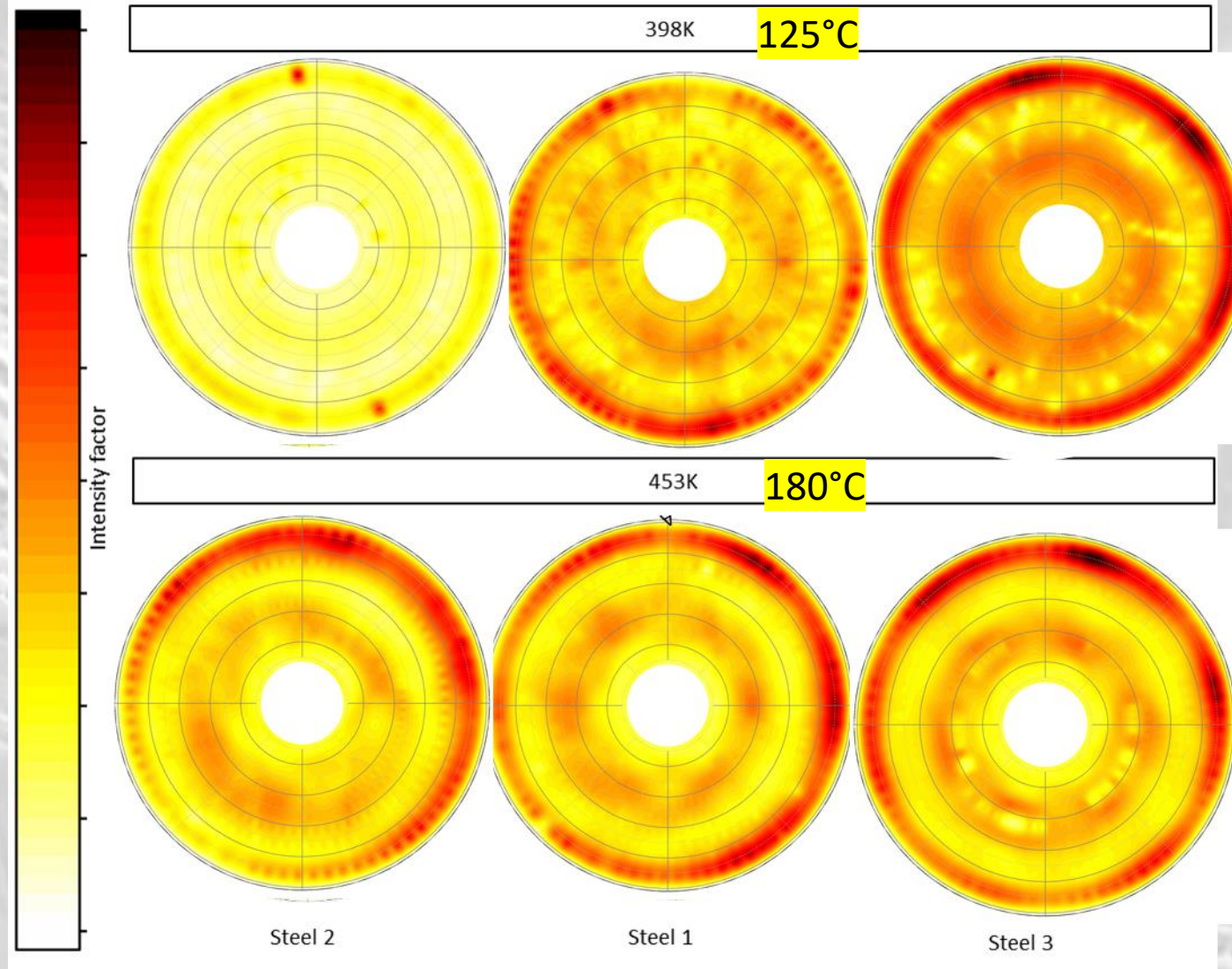
Steel 1



Steel 3

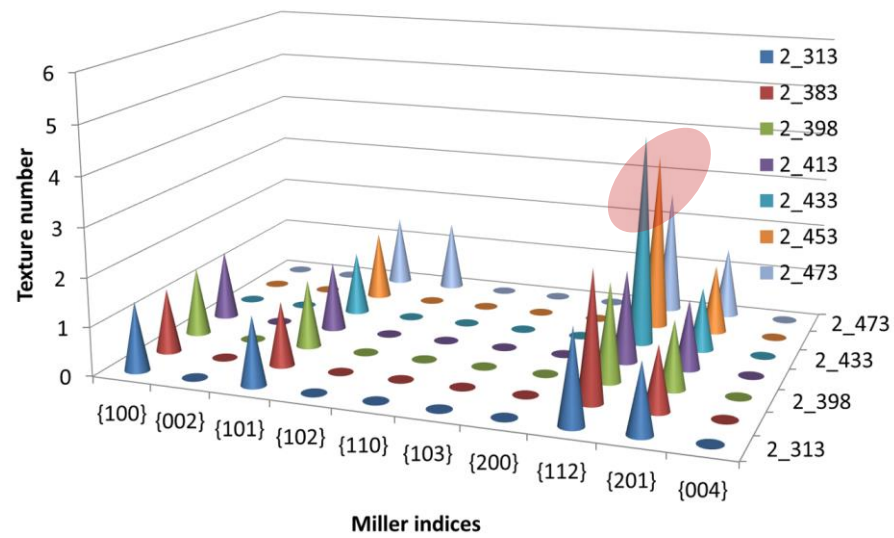


Auszenit (111) száltextúra

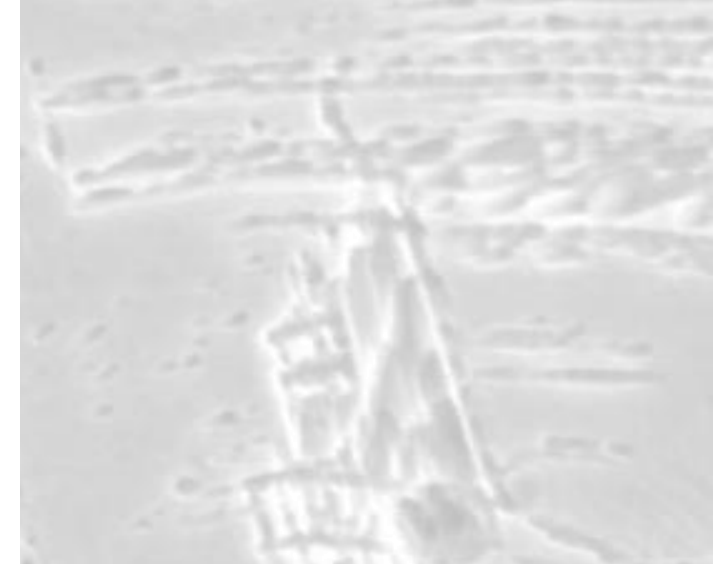
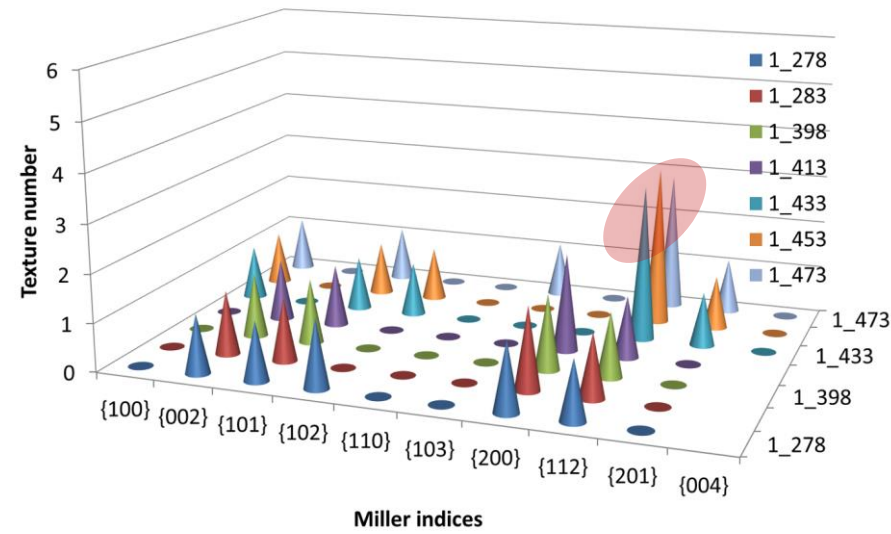


Auszenit (111) száltextúra
mellett megjelenő (311)

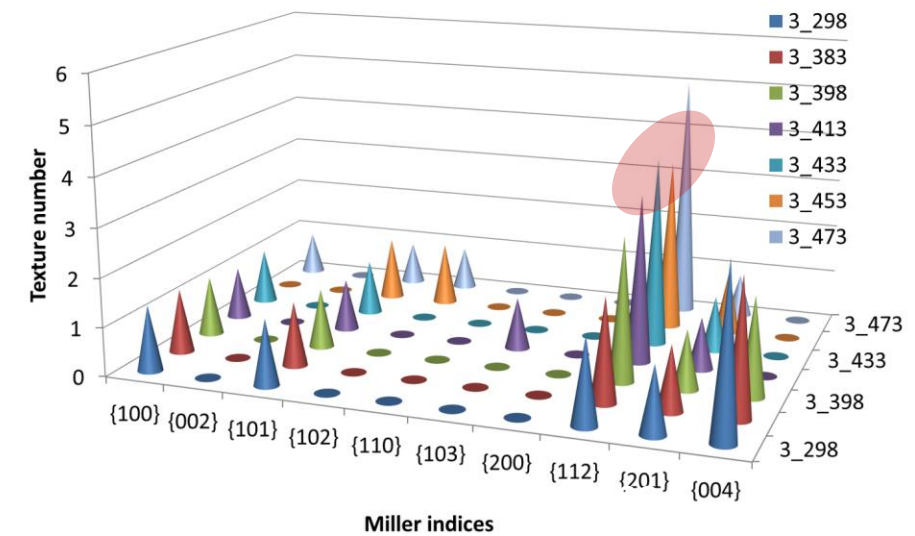
Steel 2



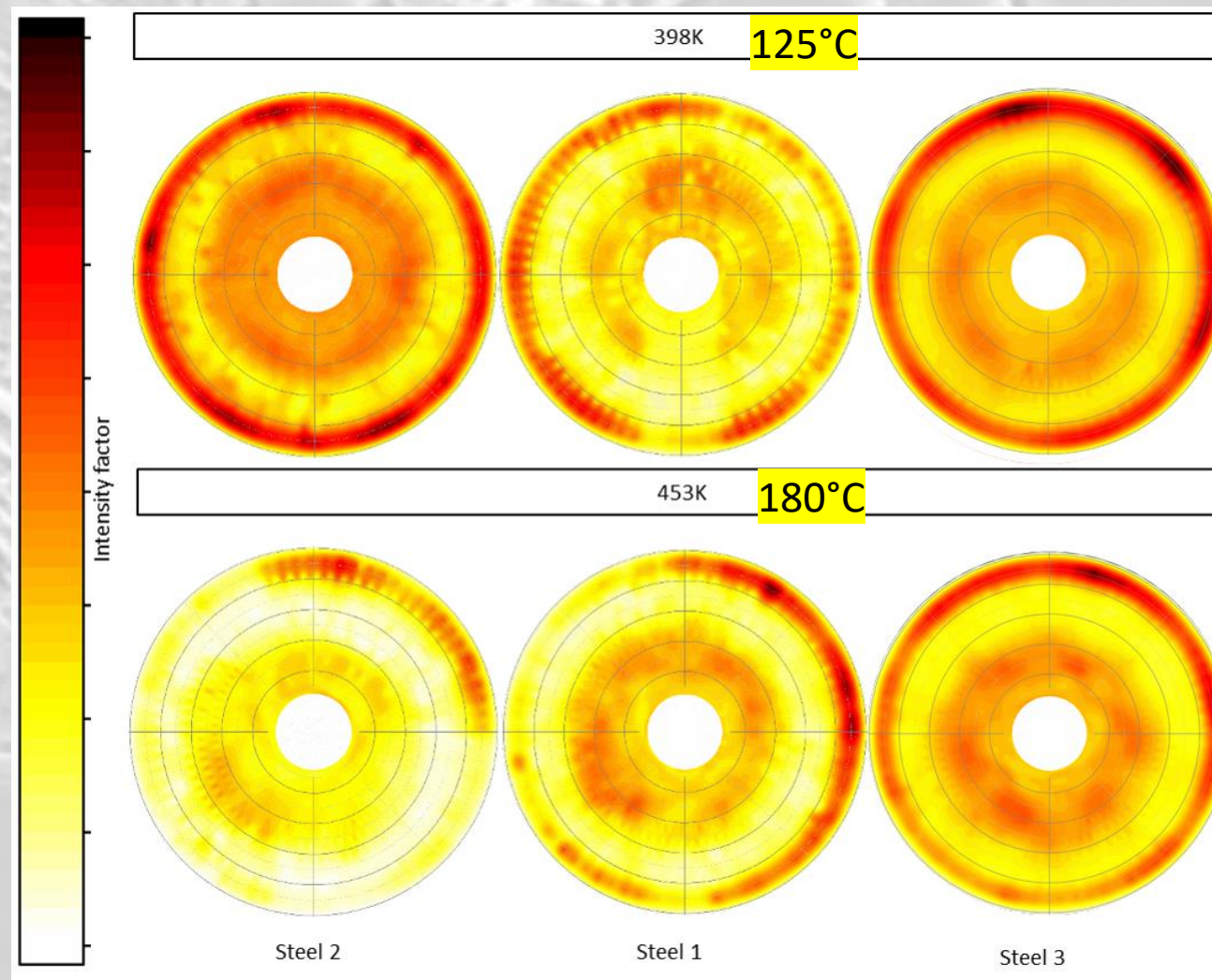
Steel 1



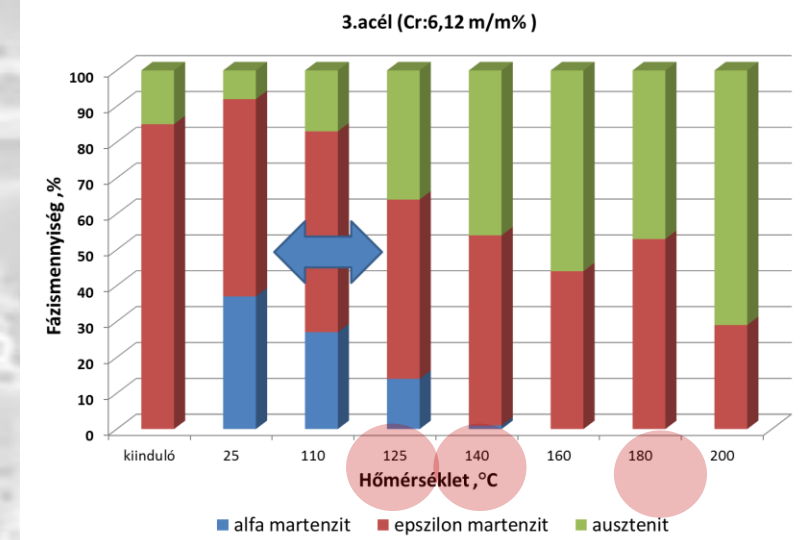
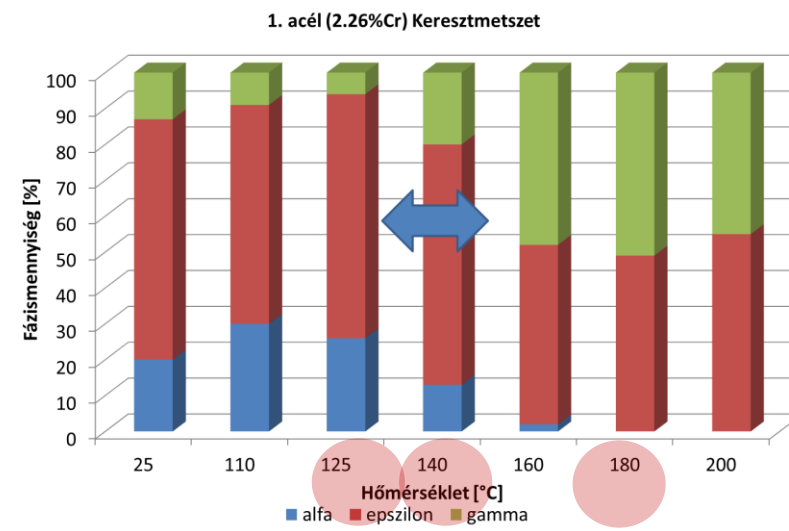
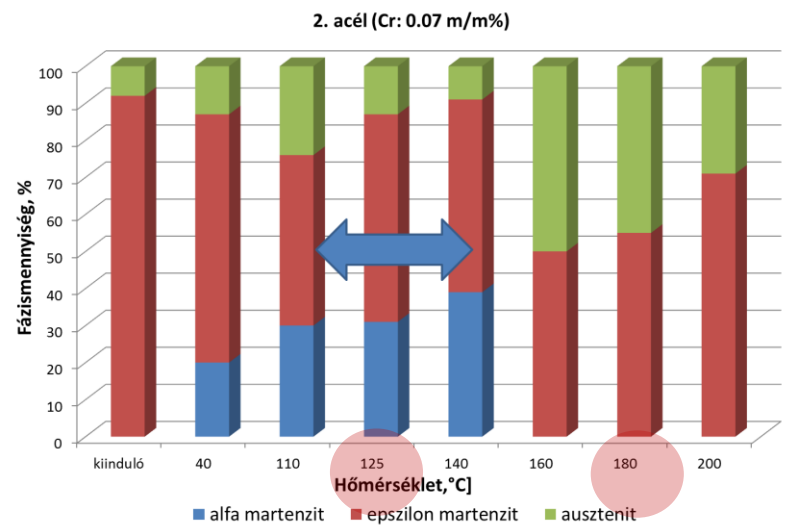
Steel 3



(112) ϵ texture

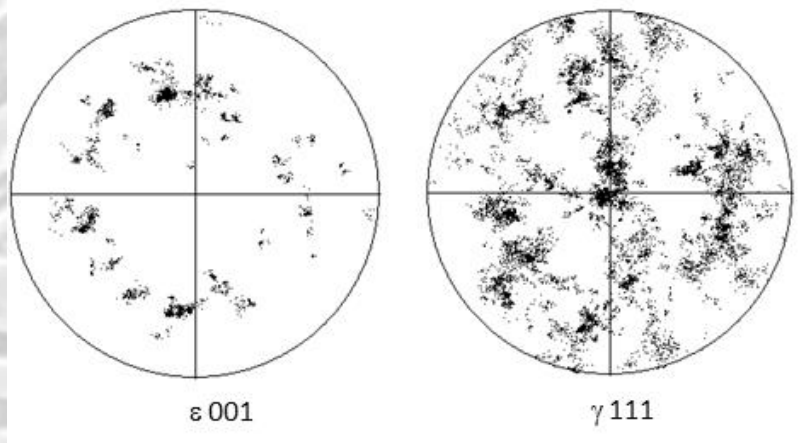
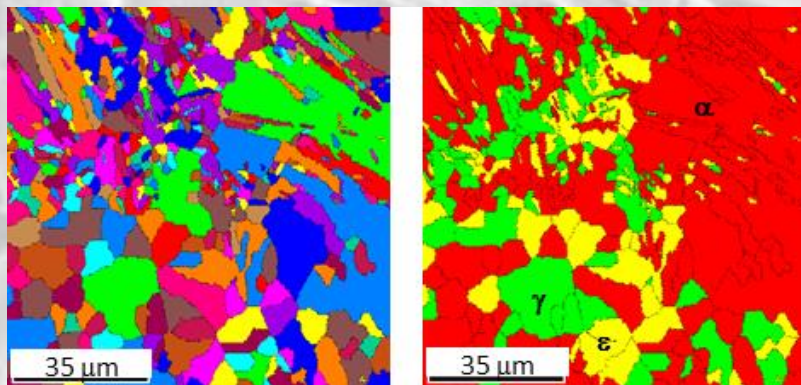


(112) ϵ martenzit pólusábra

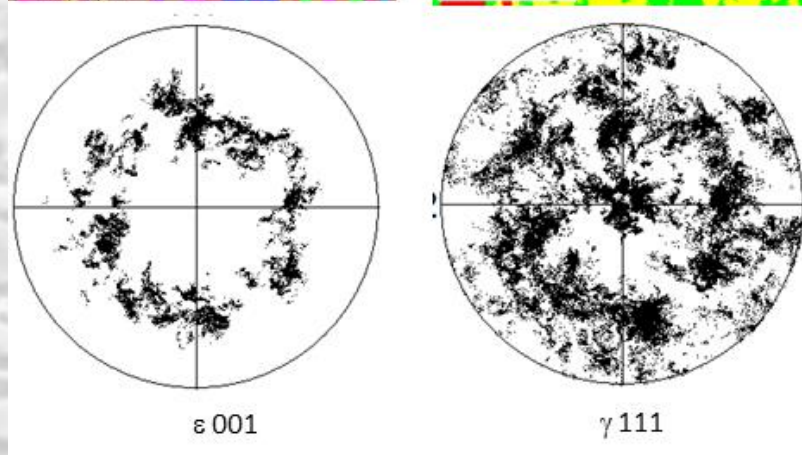
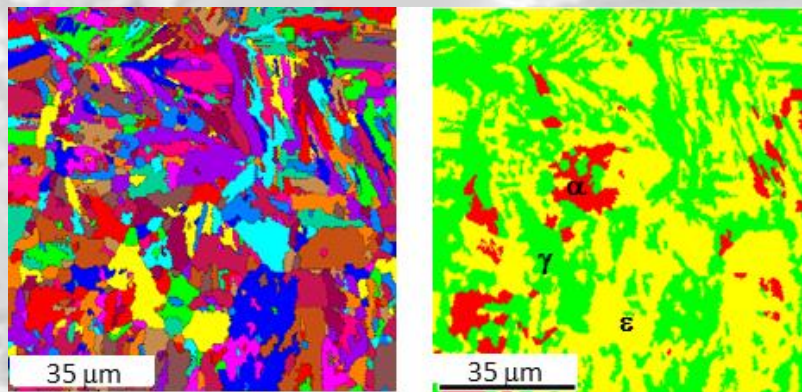


Termomechanikus kezelések
hatására végbemenő folyamatok

Cr: 2,26 125°C < Ms



Cr: 2,26 180°C > Ms

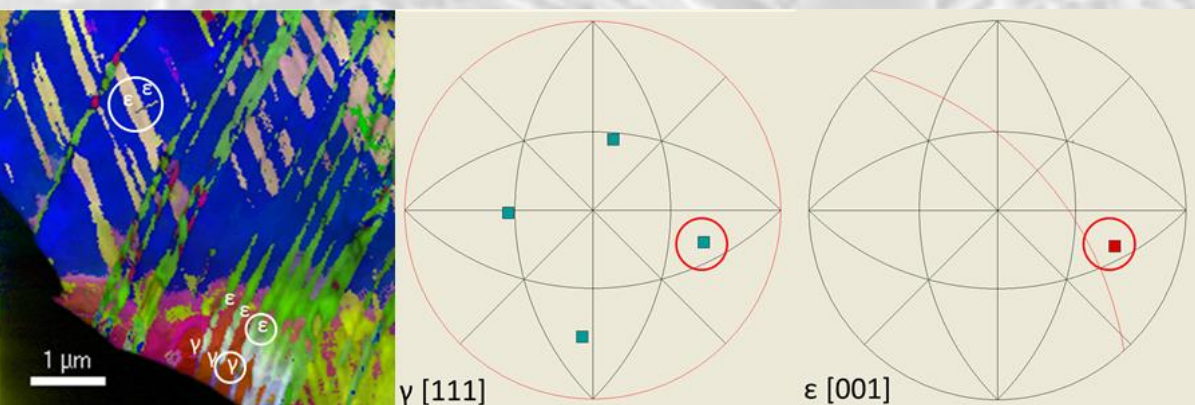


$\gamma \{111\} \parallel \epsilon \{001\}$

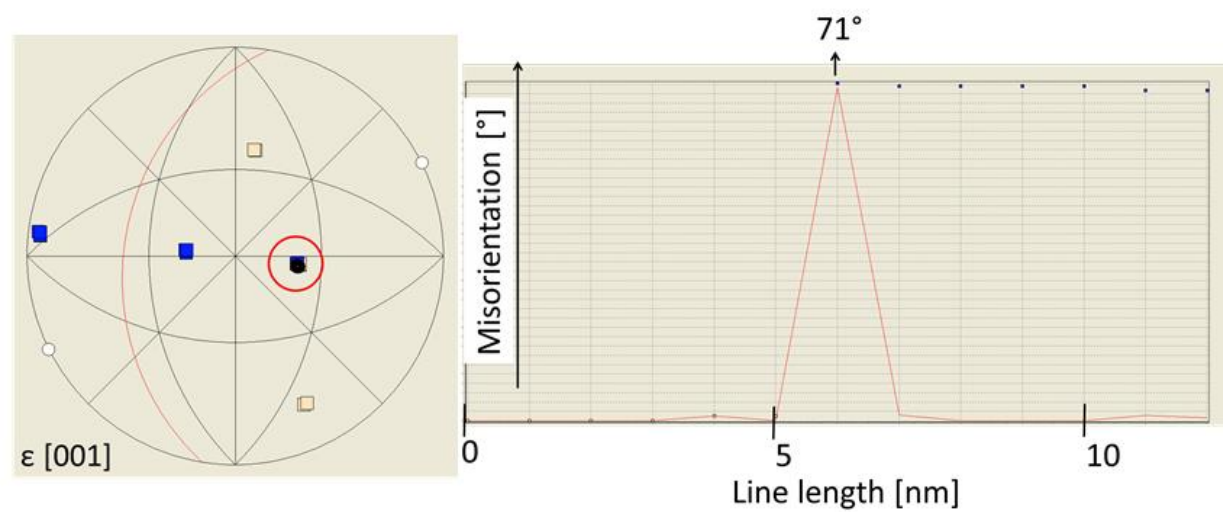
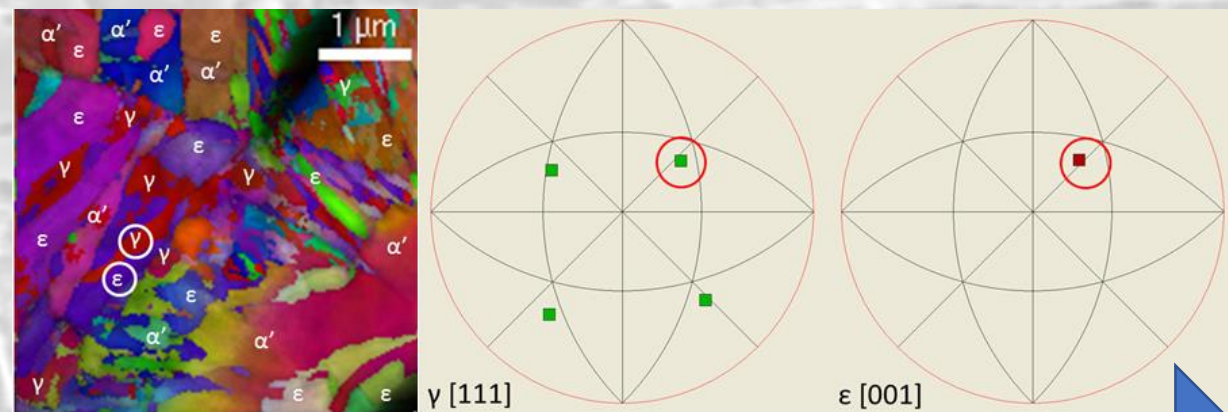


EBSD orientációs térkép,
fázistérkép, pólusábra

Cr: 6,67; 125°C



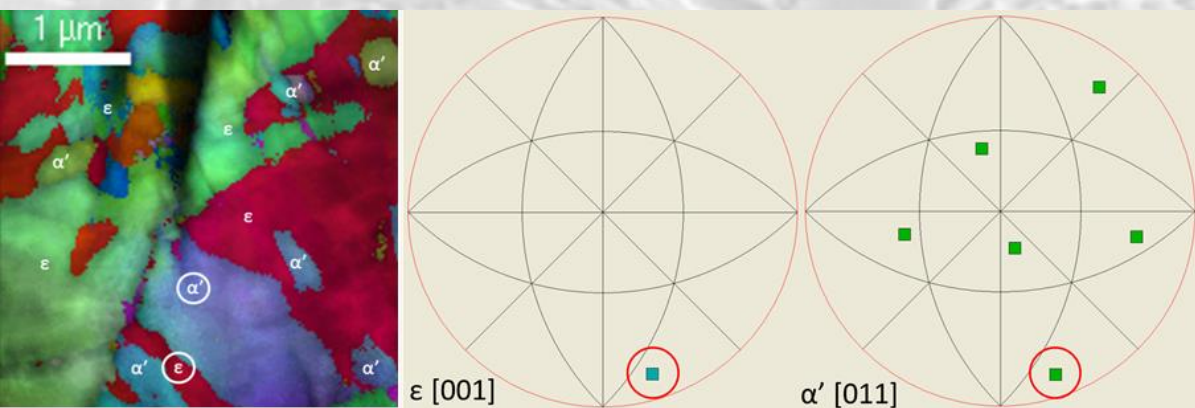
Cr: 2,26; 125°C



$\gamma \{111\} \parallel \epsilon \{001\}$

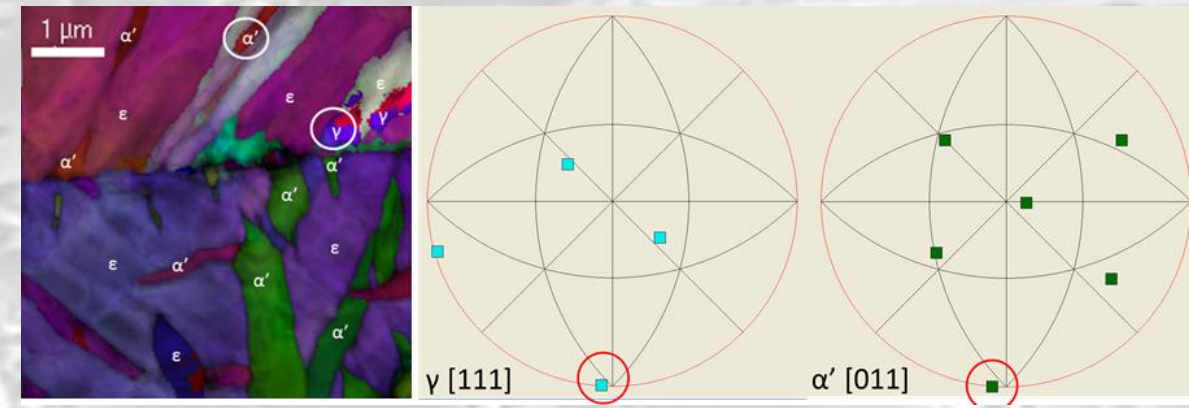
Termomechanikus kezelések
hatására végbemenő folyamatok

Cr, 6,67; 125°C



$\varepsilon [001] \parallel \alpha' [110]$

Cr, 2,26; 125°C

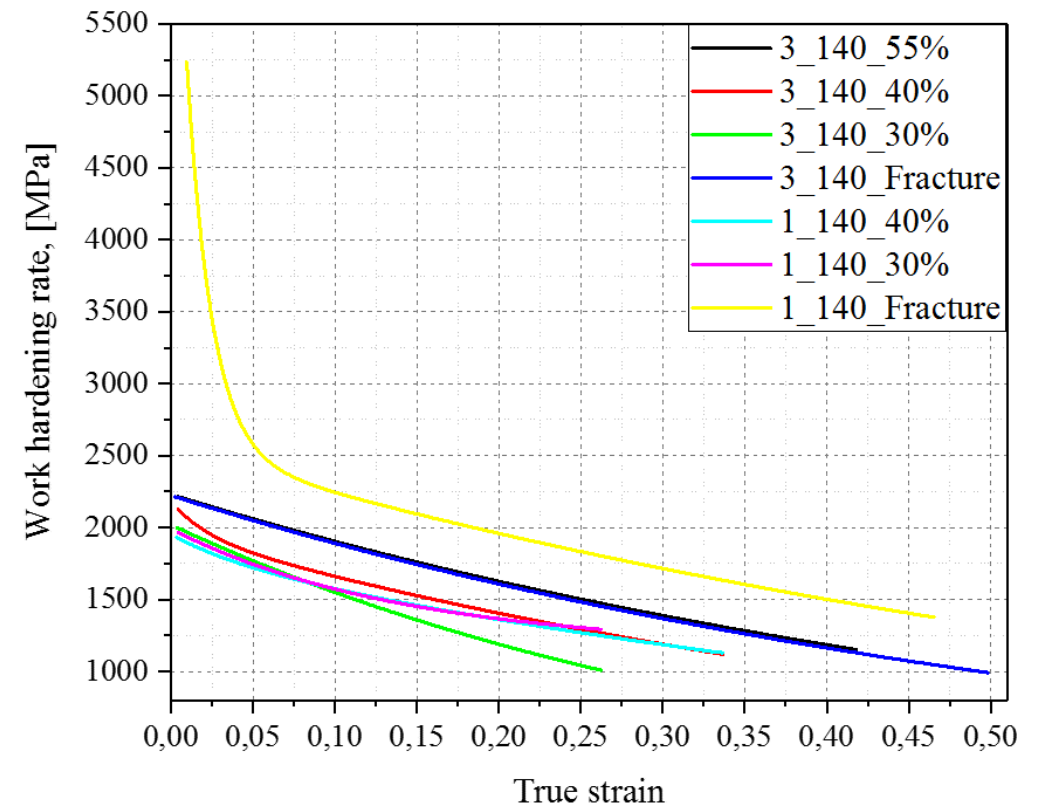
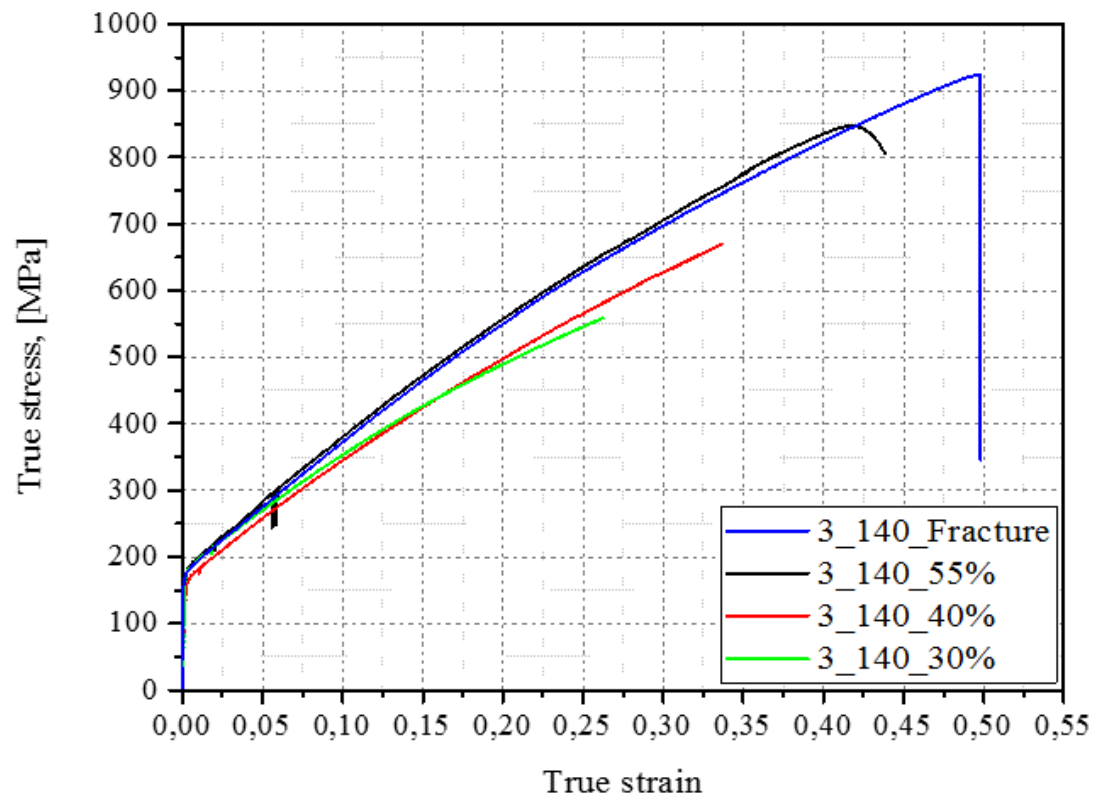


$\gamma [111] \parallel \alpha' [110]$

Benke M.: $\gamma [111] \parallel \alpha' [110]$

Kurdjumov-Sachs (K-S)
 $\gamma \{111\} \parallel \varepsilon \{001\} \parallel \alpha' \{110\}$

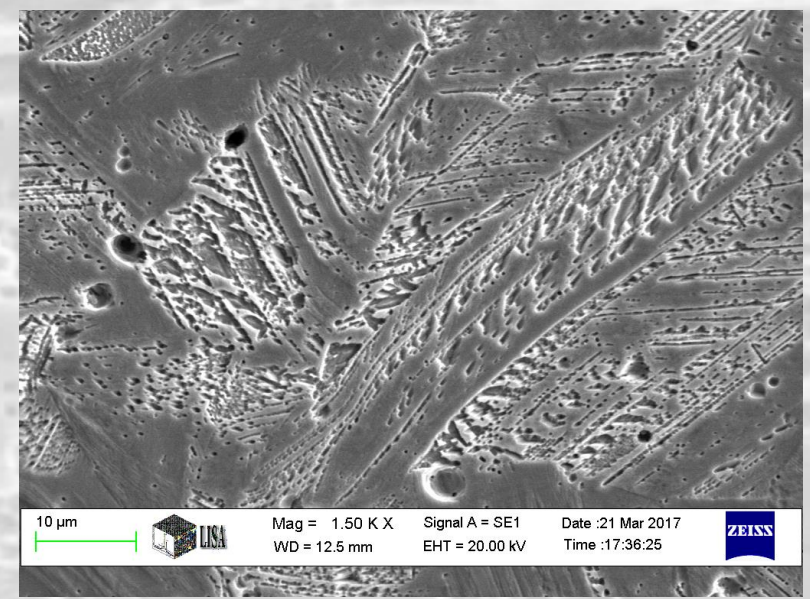
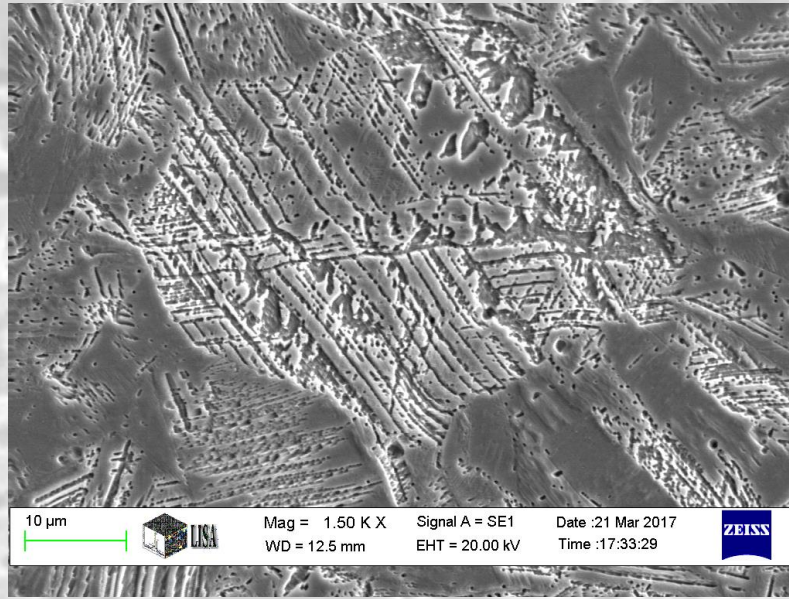
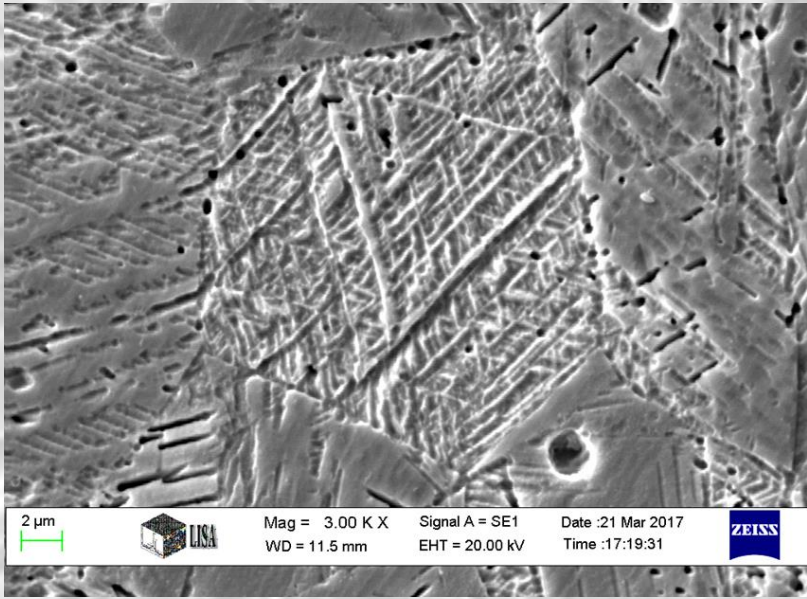
Termomechanikus kezelések
 hatására végbemenő folyamatok



Termomechanikus kezelések
hatására végbemenő folyamatok

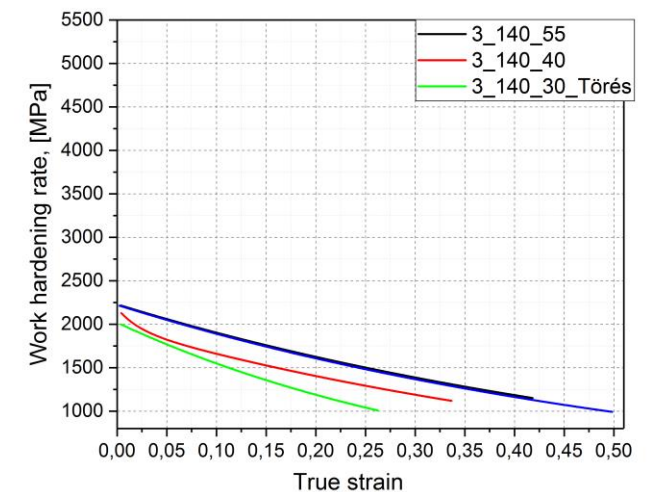
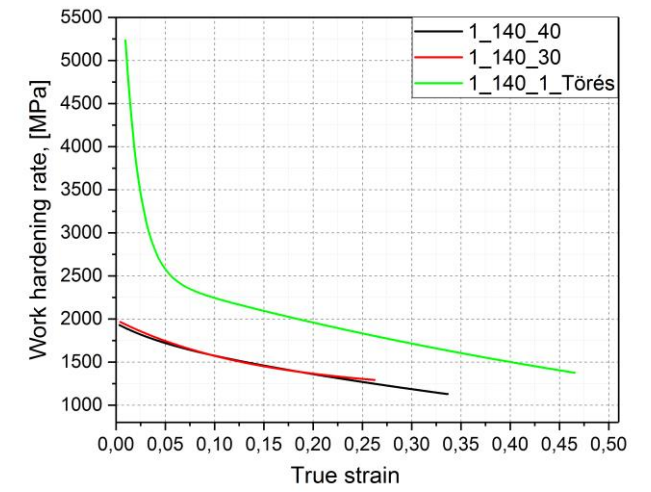
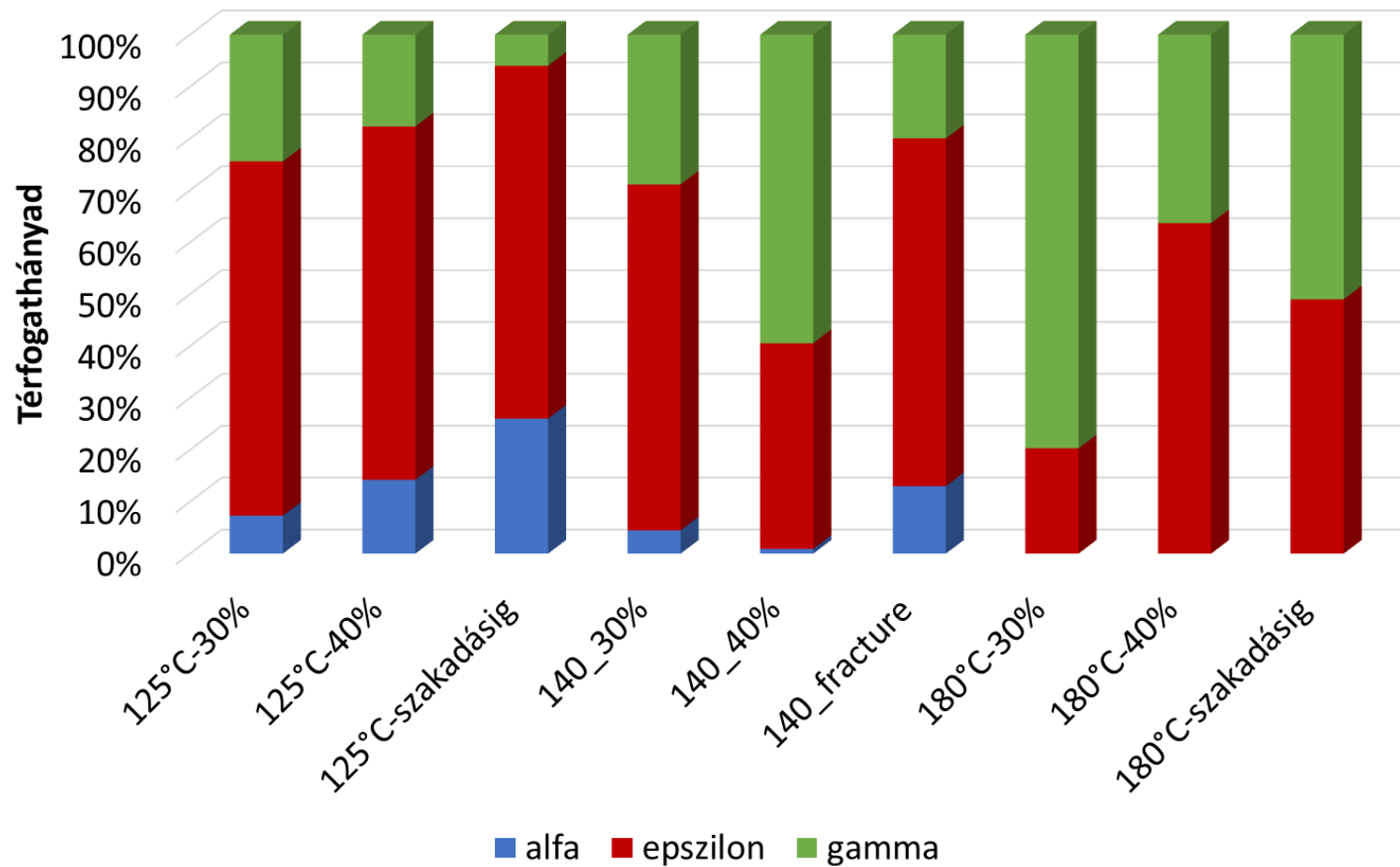
3_140_55%

3_180_40%



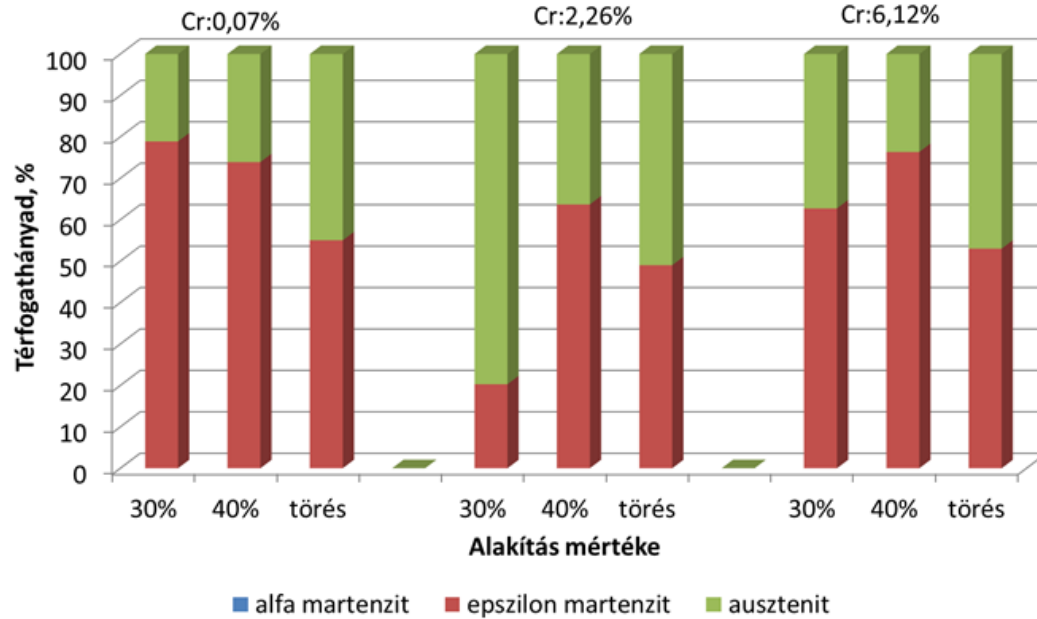
Termomechanikus kezelések
hatására végbemenő folyamatok

steel 1

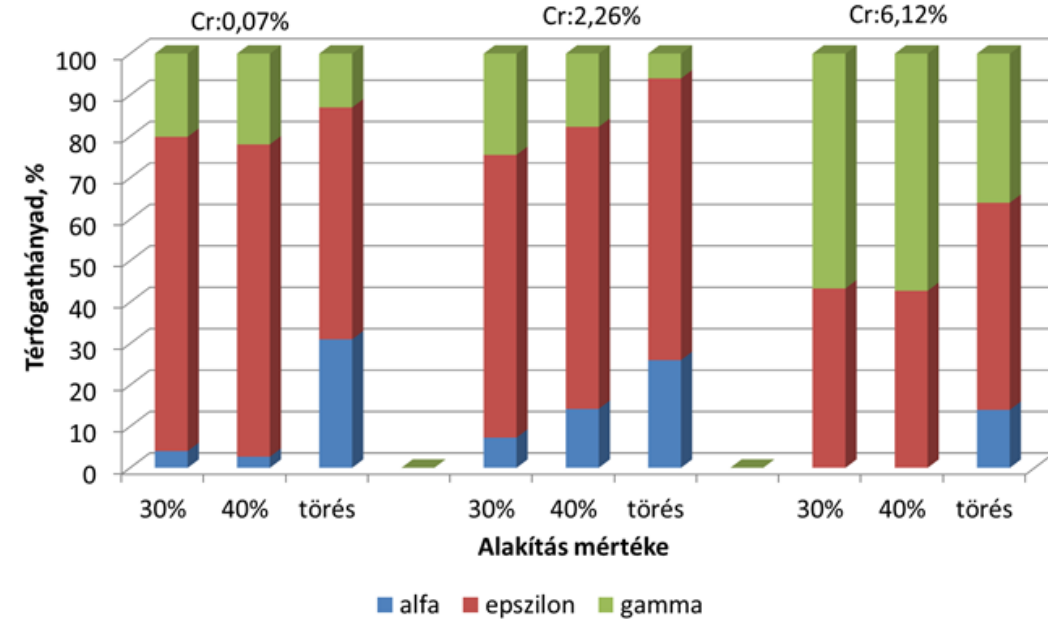


Termomechanikus kezelések
hatására végbemenő folyamatok

180°C-on kezelt minták



125°C-on kezelt minták



Termomechanikus kezelések
hatására végbemenő folyamatok



Az anizotrópia vizsgálat egy nagyon eredményes eszköz az alakváltozás indukálta martenzites átalakulás folyamatainak a követésére , de minden eszköztárunkat be kell vetni!!

Összegzés

Jelen kutatómunka az NKFI 119566K projekt keretében valósult meg.

Az előadásban ismertetett kutató munka a GINOP-2.3.2-15-2016-00027 jelű „Kristályos és amorf nanoszerkezetű anyagok kutatásával és fejlesztésével foglalkozó kiválósági műhely fenntartható működtetése” című projekt részeként – a Széchenyi 2020 keretében – az Európai Unió támogatásával valósul meg.

Köszönet