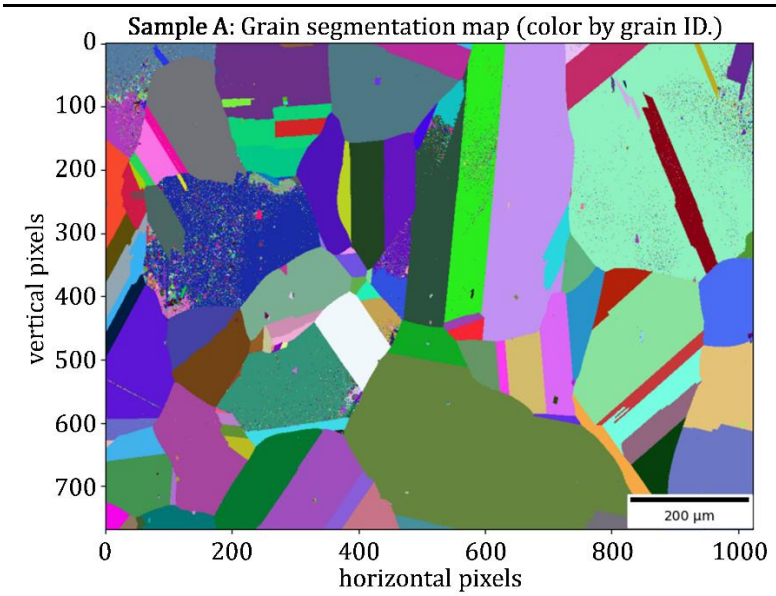
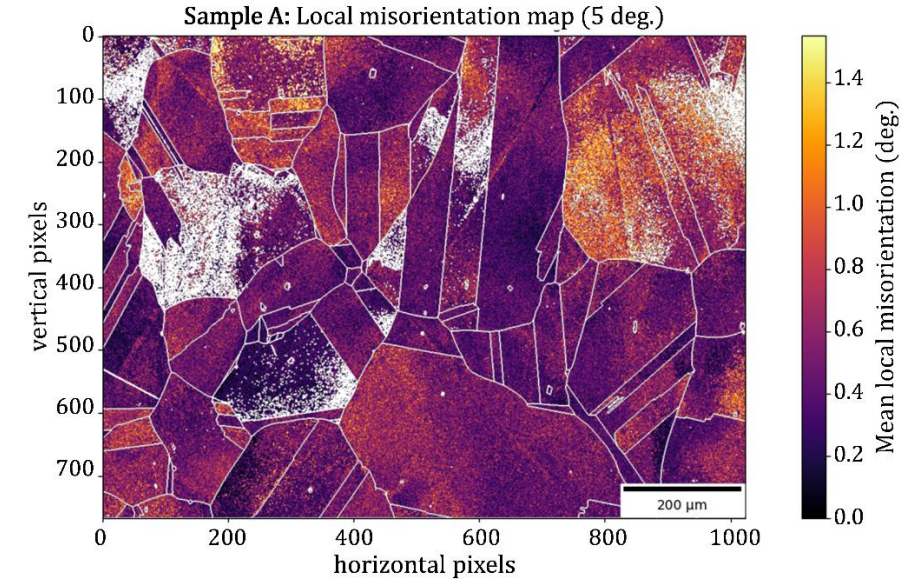
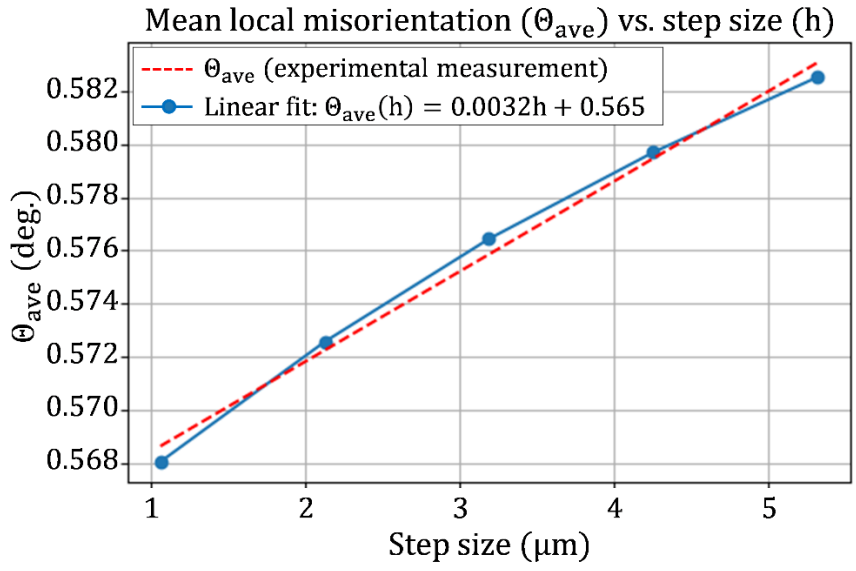
GND calculation from EBSD

Figures for sample A (as-received)

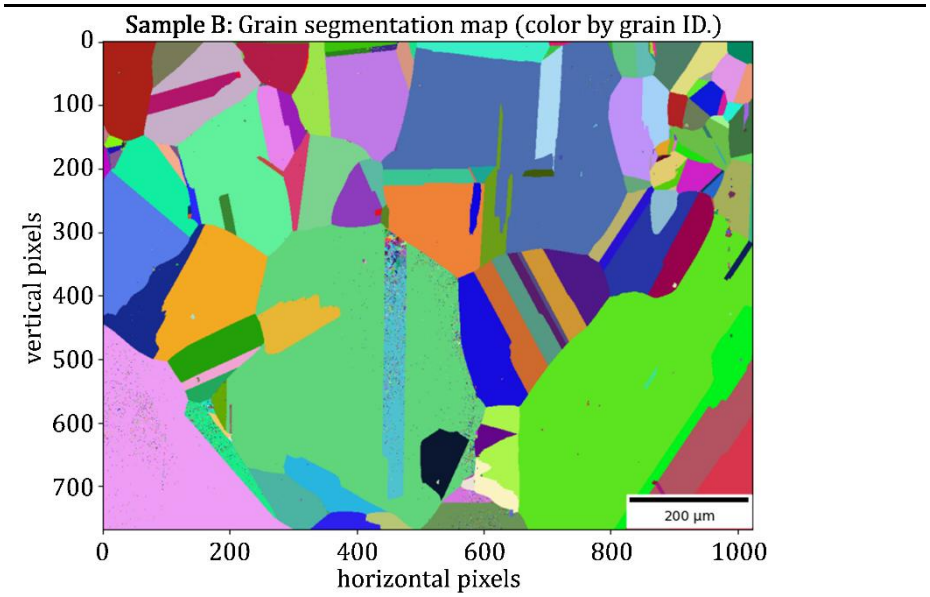


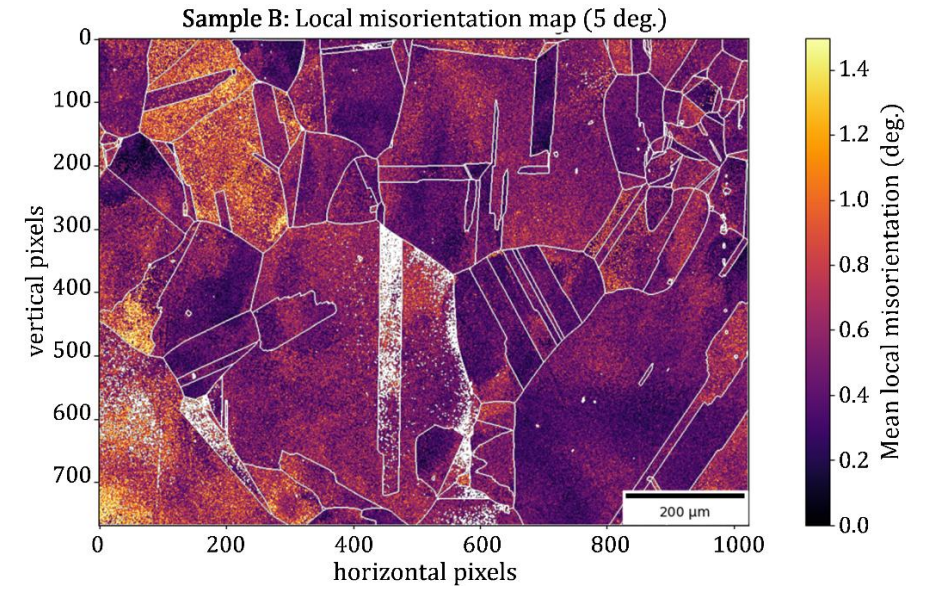


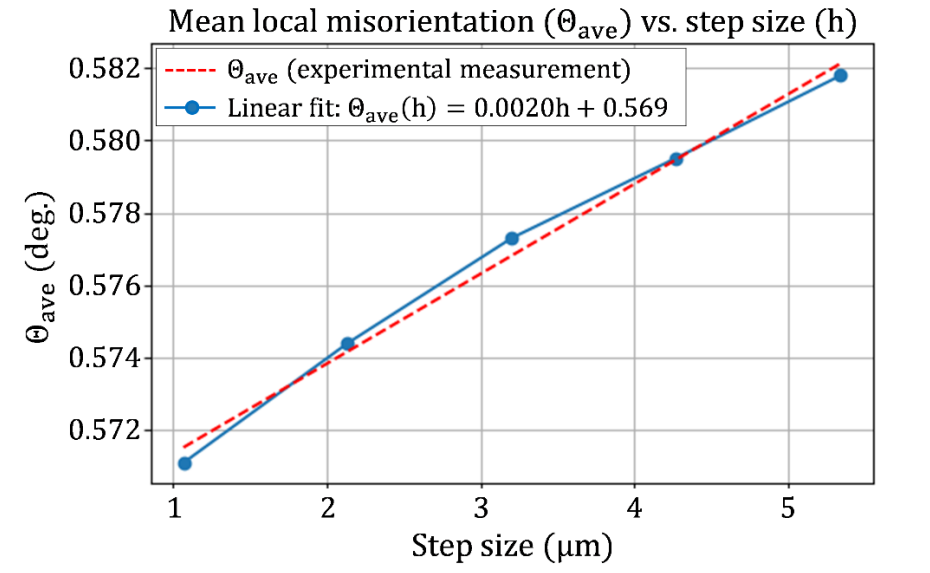


GND calculation from EBSD

Figures for sample B (as-received)

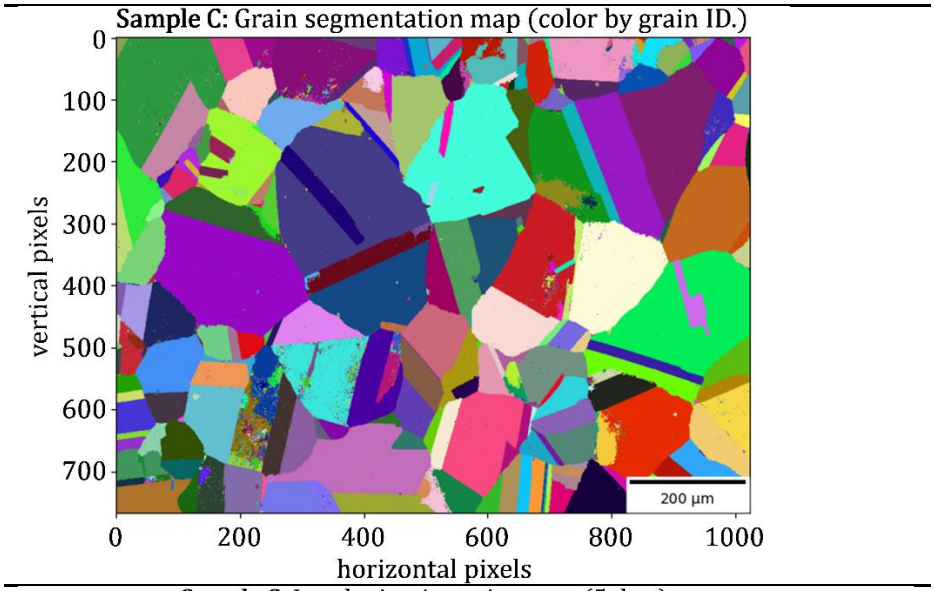


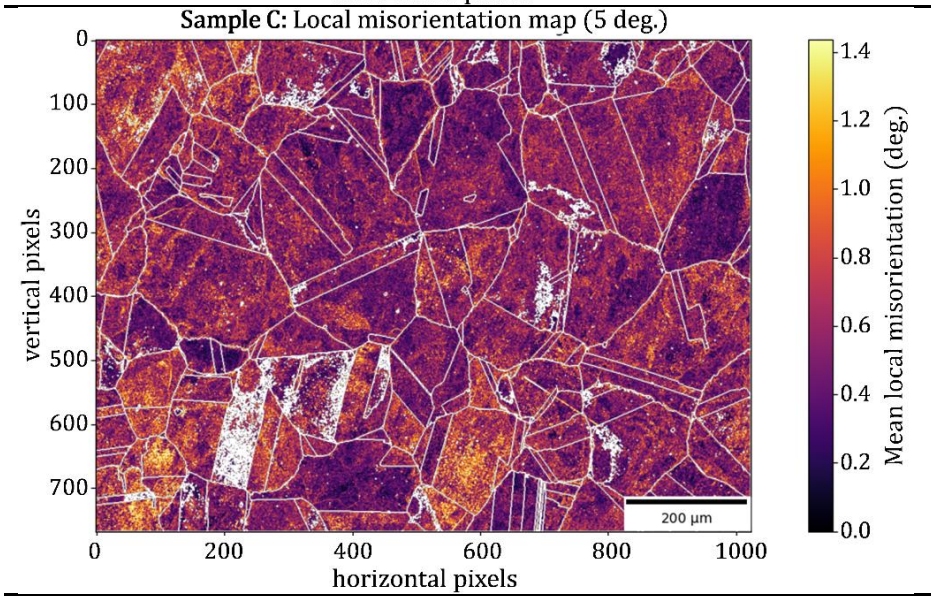


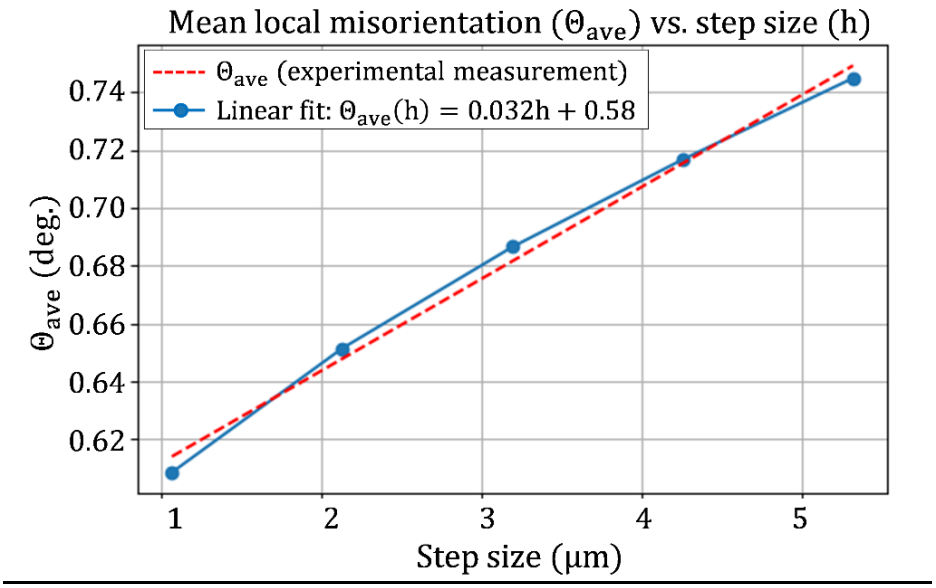


GND calculation from EBSD

Figures for sample C (creep tested until steady-state creep rate)







GND calculation from EBSD

The mean geometrically necessary dislocation density (ρ_{GND}, in m^{-2}) is calculated form the slope of the linear fit of the angular mean local misorientation ($\Theta_{\mathrm{ave}} = m_{\Theta} \cdot \mathrm{h} + n_{\Theta}$), with m_{Θ} in $\mathrm{deg} \cdot \mu\mathrm{m}^{-1}$ as:

$$\rho_{\mathrm{GND}} = \frac{m_{\Theta} \times \frac{\pi}{180} \times 10^{-6}}{\mathrm{b}}$$

where b is the Burgers vector.

On the calculation of $\mathcal{X}_{\mathrm{Cr},0}$

The decision to neglect the carbon atoms was made upon considering the following reasons:

(a) the larger size of the Cr atoms (covalent radius=166 pm) compared to carbon (67 pm)
(b) the larger number of Cr atoms (23) compared to the 6 C atoms.

Equation (8) computes the solid solution stress (σ_{ss}) as $\sigma_{\mathrm{ss}} = f_{ss} \cdot \mathcal{X}_{\mathrm{Cr}}^{2/3}$, where $\mathcal{X}_{\mathrm{Cr}}$ is the concentration of Cr atoms in solid solution (particles per mol). $\mathcal{X}_{\mathrm{Cr}}$ is calculated from the volume fraction of $Cr_{23}C_6$ particles obtained after the thermokinetic Thermo-Calc® simulations ($\mathcal{X}_{\mathrm{Cr23C6}}$) by solving the following equation:

$\mathcal{X}_{\mathrm{Cr}} = \mathcal{X}_{\mathrm{Cr23C6}} \cdot \frac{23 \times \mathrm{Vol}_{\mathrm{Cr}}}{6 \times \mathrm{Vol}_{\mathrm{C}} + 23 \times \mathrm{Vol}_{\mathrm{Cr}}}$, where Vol_i is the volume of the i atom calculated using the van der Waals radii.

In case of Cr and C, $\mathrm{Vol}_{\mathrm{Cr}} = 1.92 \times 10^{-29}$ m^3, whereas $\mathrm{Vol}_{\mathrm{C}} = 1.26 \times 10^{-30}$ m^3.

Replacing these two magnitudes in our formula, the factor $\frac{23 \times \mathrm{Vol}_{\mathrm{Cr}}}{6 \times \mathrm{Vol}_{\mathrm{C}} + 23 \times \mathrm{Vol}_{\mathrm{Cr}}} = 0.983$

In other words, Cr atoms are responsible for more than 98% of the total volume fraction of particles produced from the dissolution of $Cr_{23}C_6$.

Finally, the elastic and size moduli misfit of Cr atoms in Ni-based FCC lattice being already studied in (M.A. Moretti et al., Met. Mat. Trans. A, 2023; cited as [55] in our manuscript), we decided to consider exclusively Cr atoms.