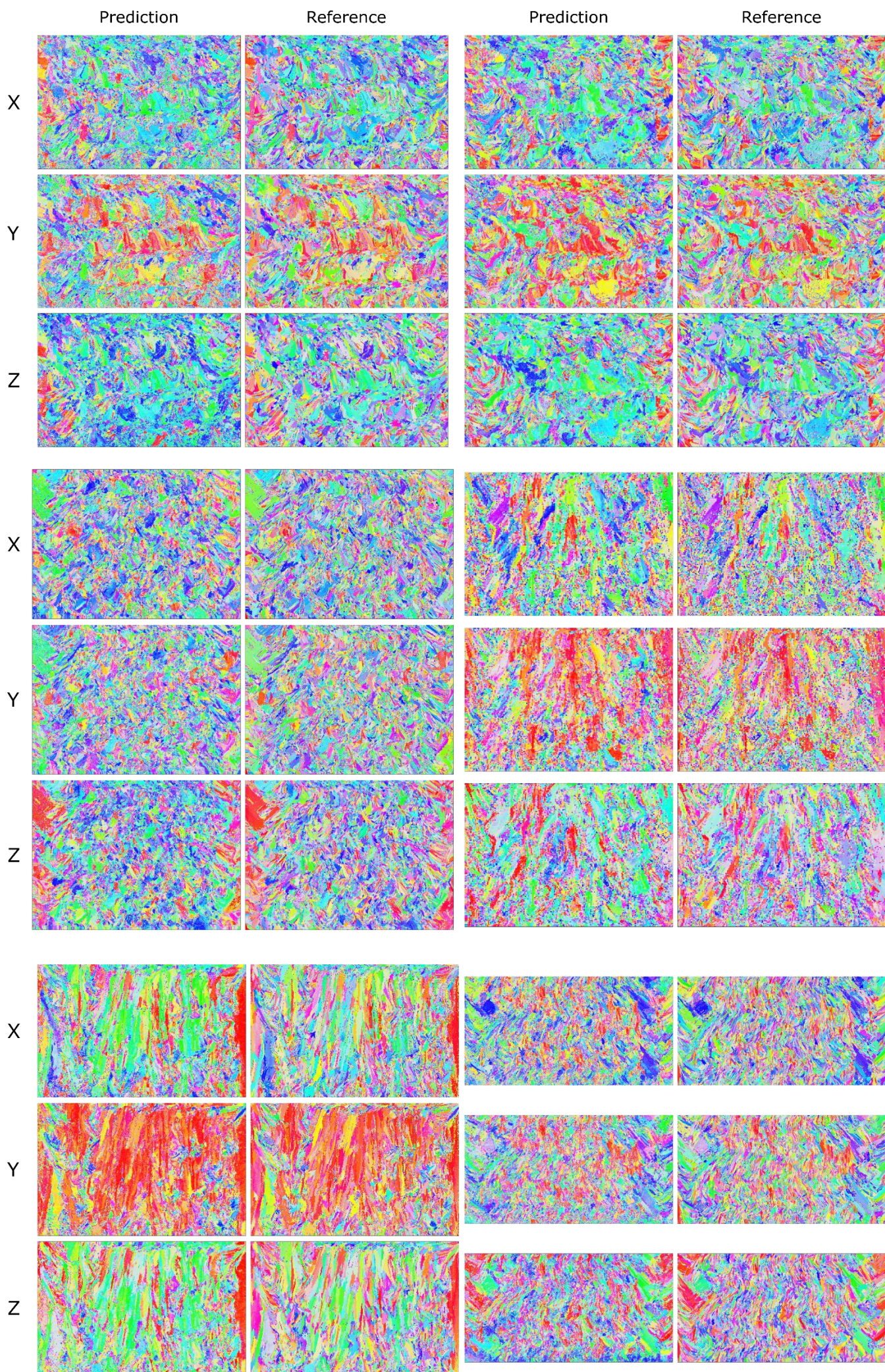
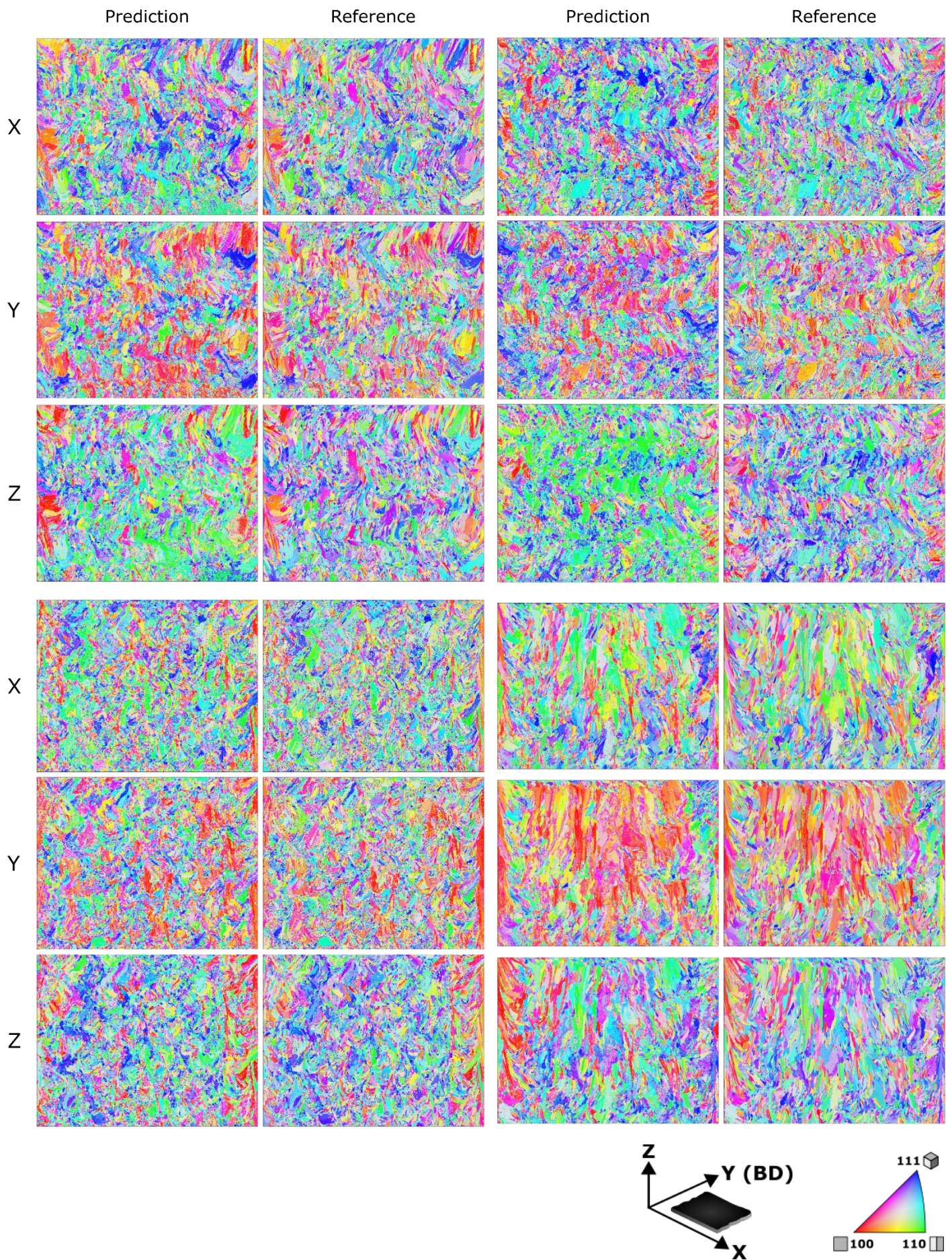
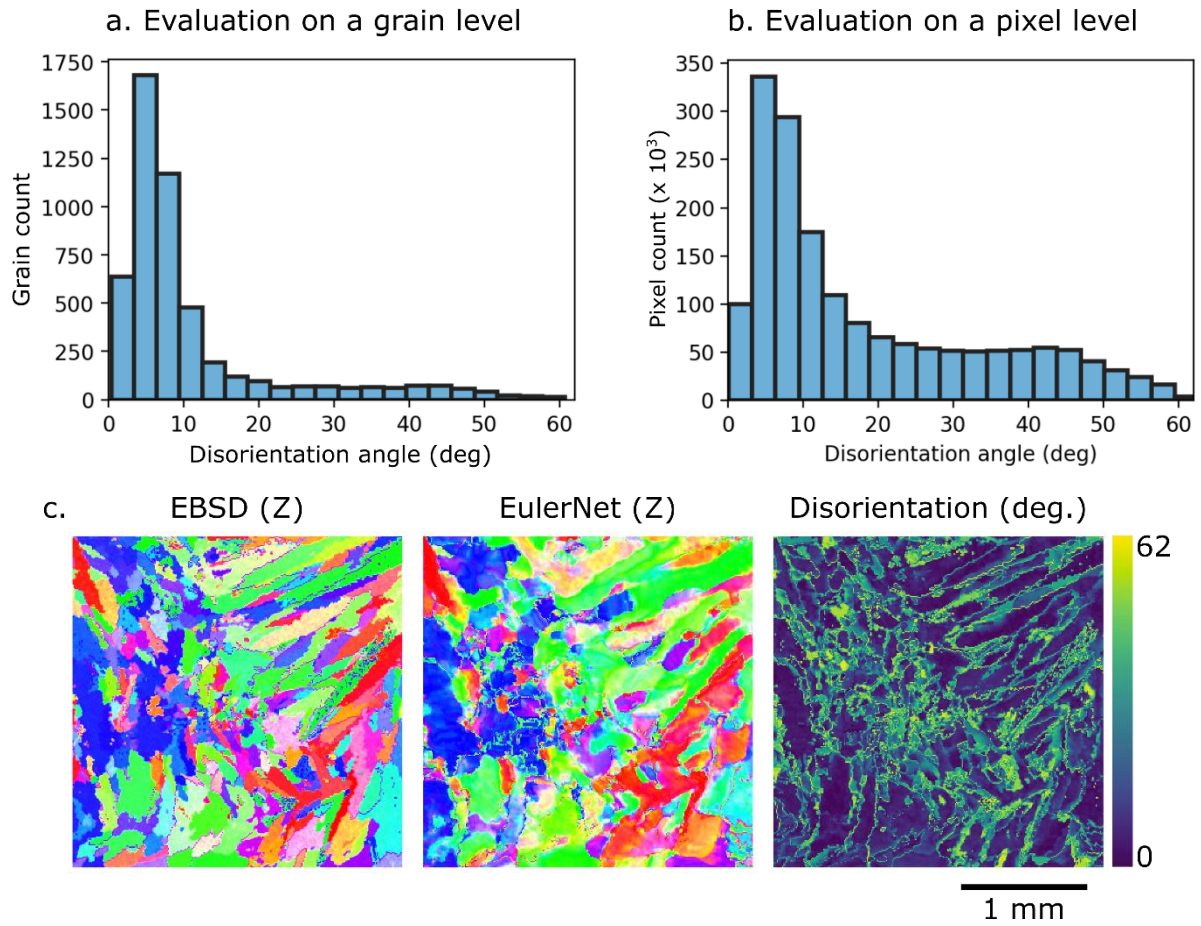






Supplementary Figure 1 | Comparison between the IPF maps produced by our EulerNet model from directional reflectance (“Prediction”) and the ground truth EBSD maps (“Reference”) in the hold-out specimen of each cross-validation split.



Supplementary Figure 2 | Comparison between the disorientation error measured on (a) a grain level by selecting pixels from the center of each grain (the mean disorientation is $6.7^\circ \pm 0.8^\circ$) and (b) a pixel level without any filtering of the data (the mean disorientation is $11.7^\circ \pm 1.5^\circ$). The higher error in the pixel-wise evaluation is largely due to the inaccurate registration between DRM and EBSD datasets. Because of the misregistration, pixels in the vicinity of grain boundaries and in small-grained regions are mislabeled and contribute substantially to the counts in (b). (c) This effect is clearly noticeable when mapping the spatial distribution of the disorientation error, which grows abnormally at those specific locations.

Specimen	Power (W)	Translating speed (mm/min)	Layer height (mm)	Powder feed rate (g/min)
#01	1600	430	1.35	7.2
#02	1600	430	1	5.5
#03	1600	430	1	5
#04	1400	430	1	5
#05	1600	1070	2	15
#06	1600	1070	2	15
#07	1600	610	2.5	15
#08	1600	610	2.5	15
#09	1600	430	4	15
#10	1600	430	4	15

Supplementary Table 1 | DED printing parameters of the specimens.