Supplementary Information

Deep learning-based noise filtering toward millisecond order imaging by using scanning transmission electron microscopy

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A. Results of deep learning filter with and without distortion correction for entire field-of-view

This section shows results of deep learning filter (DLF) trained with and without the distortion correction (DC) described in the Method section. The test images of 50[frames]×16[field-of-view (FOVs)] were processed through the DLF. Figure A.1 indicates of the rapid scan images and those filtered by DLF without DC and DLF with DC, respectively, for all fields-of-view, where the slow scan images are also shown as a reference. The DLF with DC is the same as DLF-Slow in the main article and the DLF without DC was trained in the same condition as the DLF-Slow. As noted in

the main article, the rapid image acquisition of STEM causes non-linear image distortion as clearly visualized in Fig.1(a), resulting in the misfit of dislocation position. Without the DC, the DLF generated undesired artifacts as shown in the second column of Fig.A.1, because the DL network would try to fit each of dislocation positions, whose process involves both the elimination of dislocations in the original images and the generation of those at positions where dislocations exist in the reference images. The transformation which requires the generation of objects easily causes artifacts and may need numerous training data set to prevent. The DLF with DC, on the other hand, successfully reproduces the slow scan images for all fields-of-view. Therefore, the effectiveness of the DC has been clearly represented in the figure.

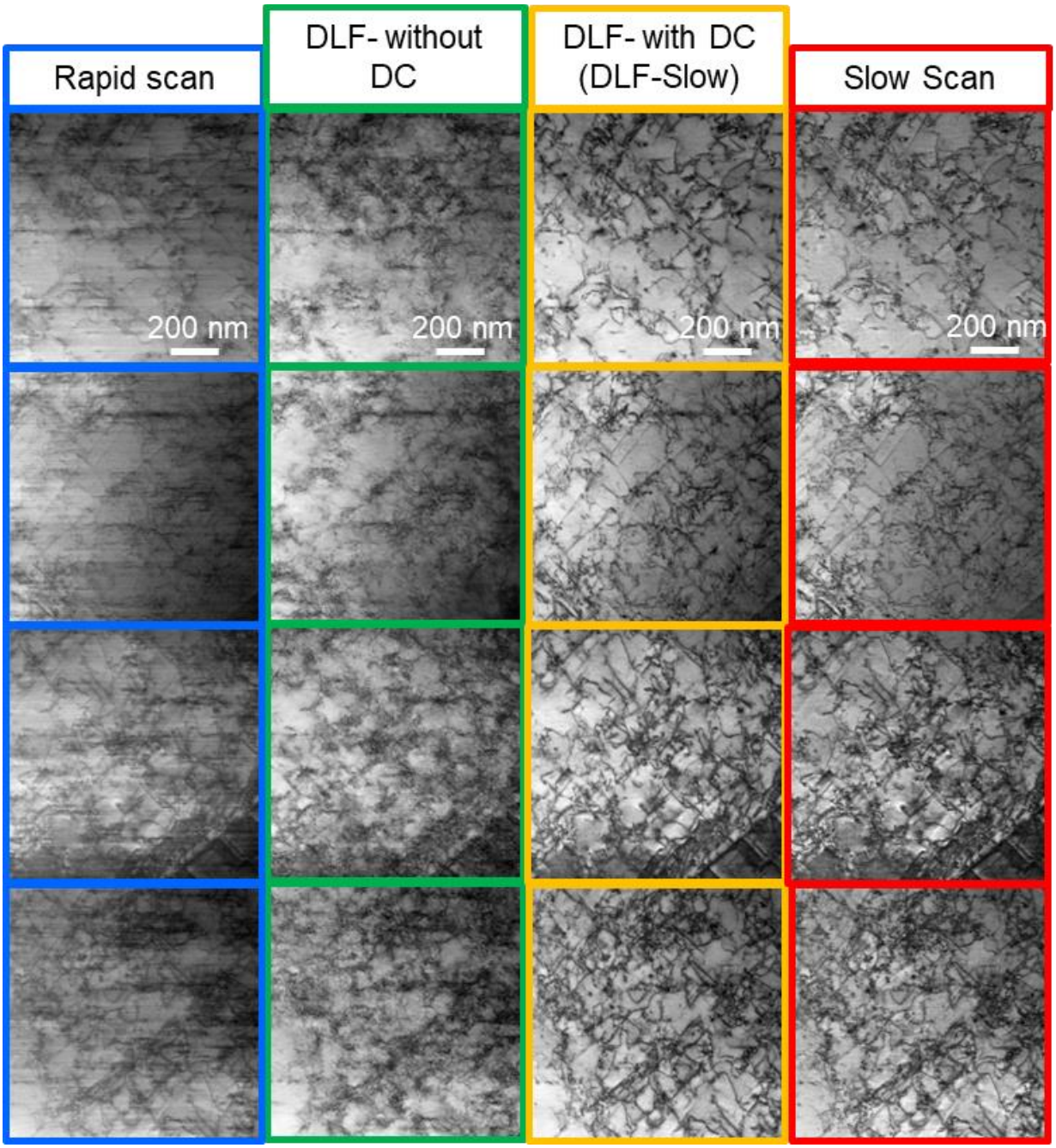

Fig.A.1 Rapid scan images and results of DLF processed images for all FOVs. Slow scan images are also shown as a reference.

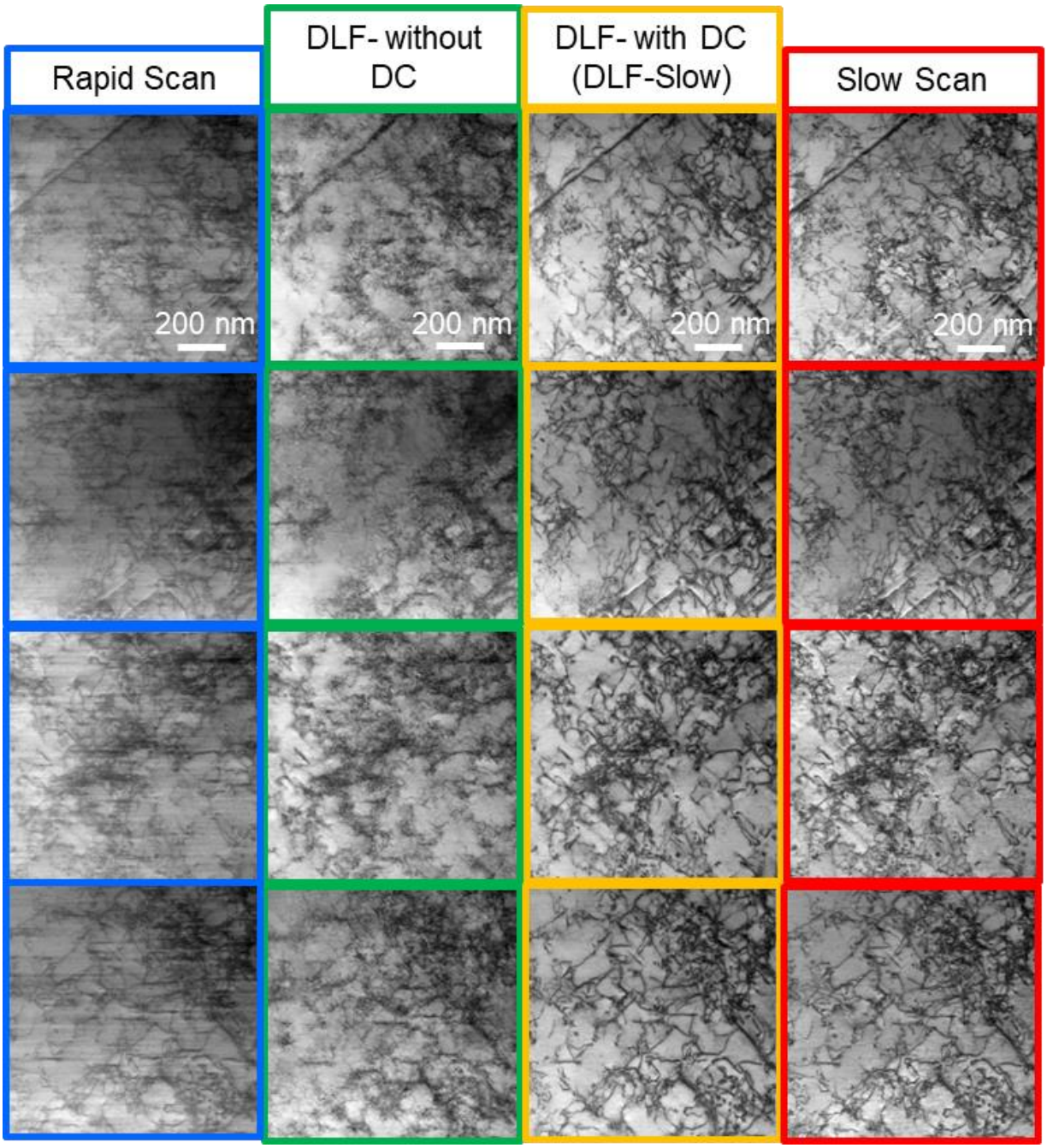

Fig.A.1 Continued

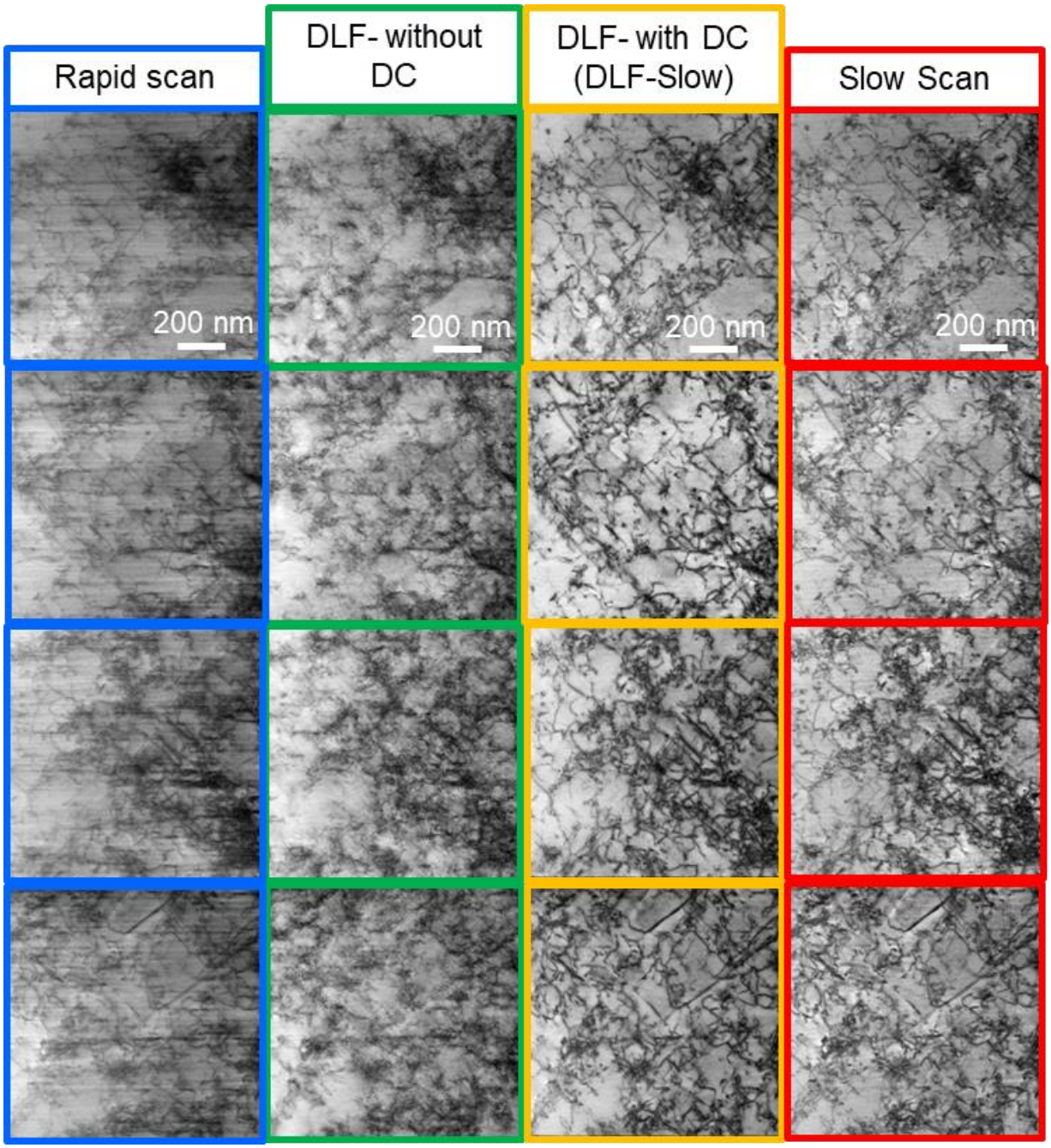

Fig.A.1 Continued

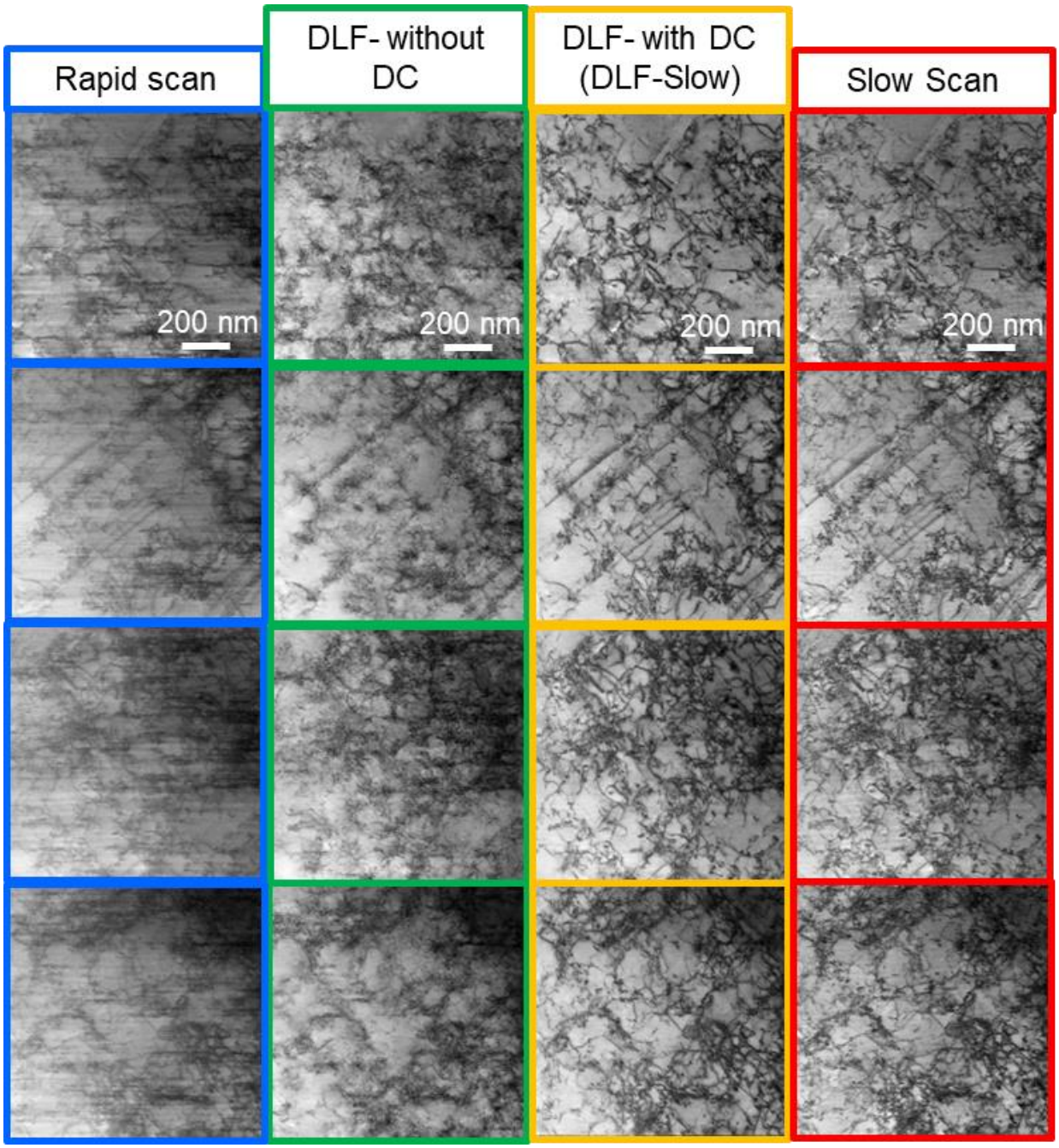

Fig.A.1 Continued