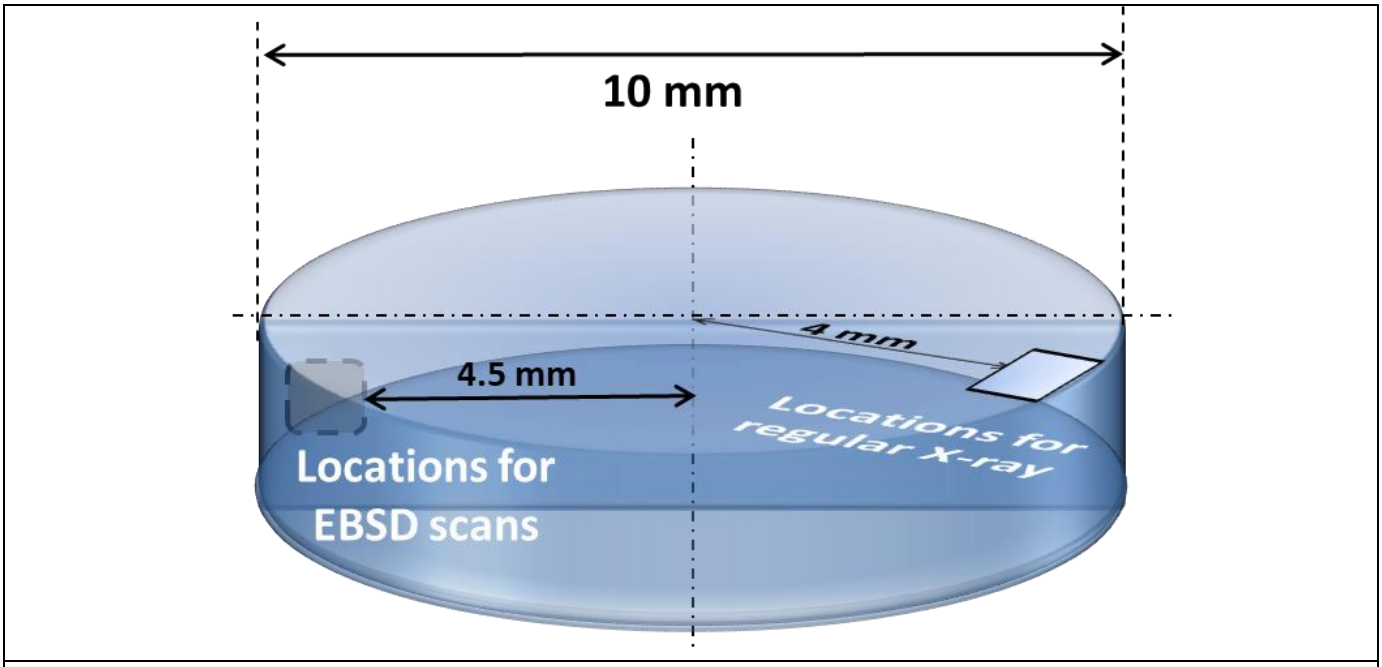
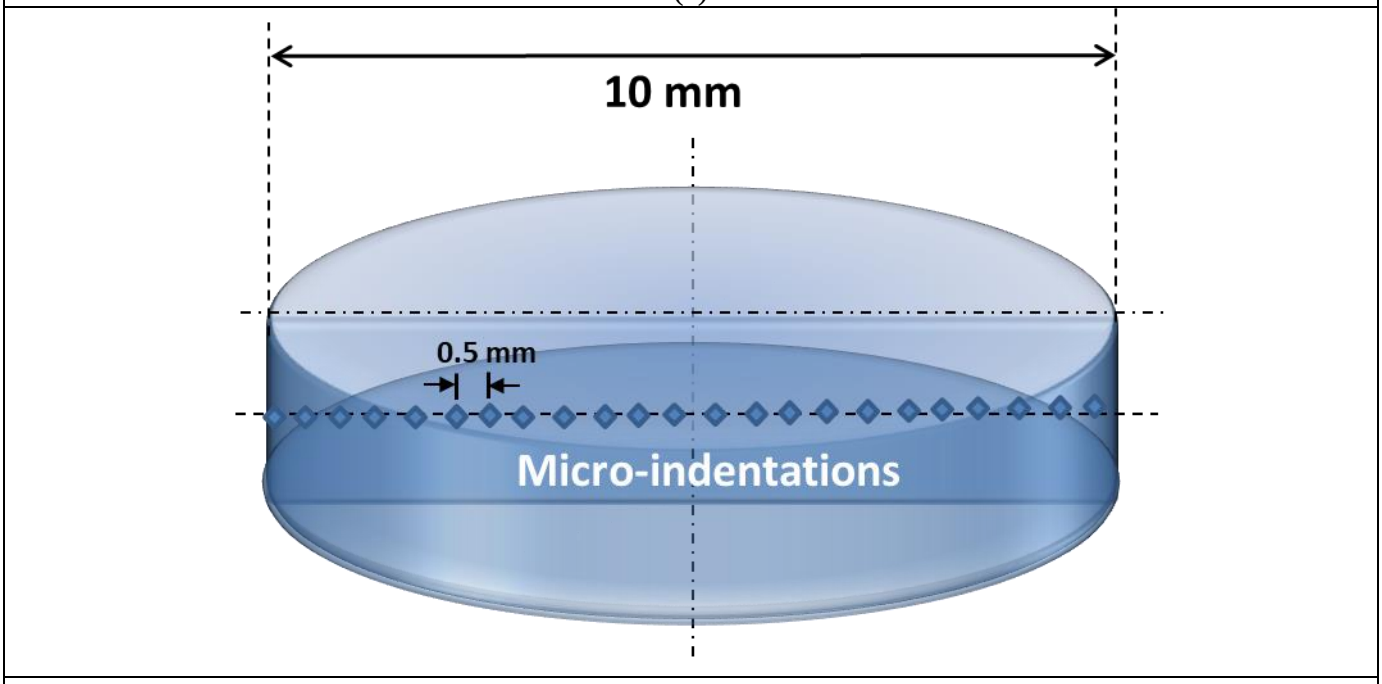


(a)



(b)

Figure 1: Schematic showing (a) the locations for EBSD scans and regular X-ray measurement and (b) the scheme of micro- hardness measurement on the HPT-processed discs.

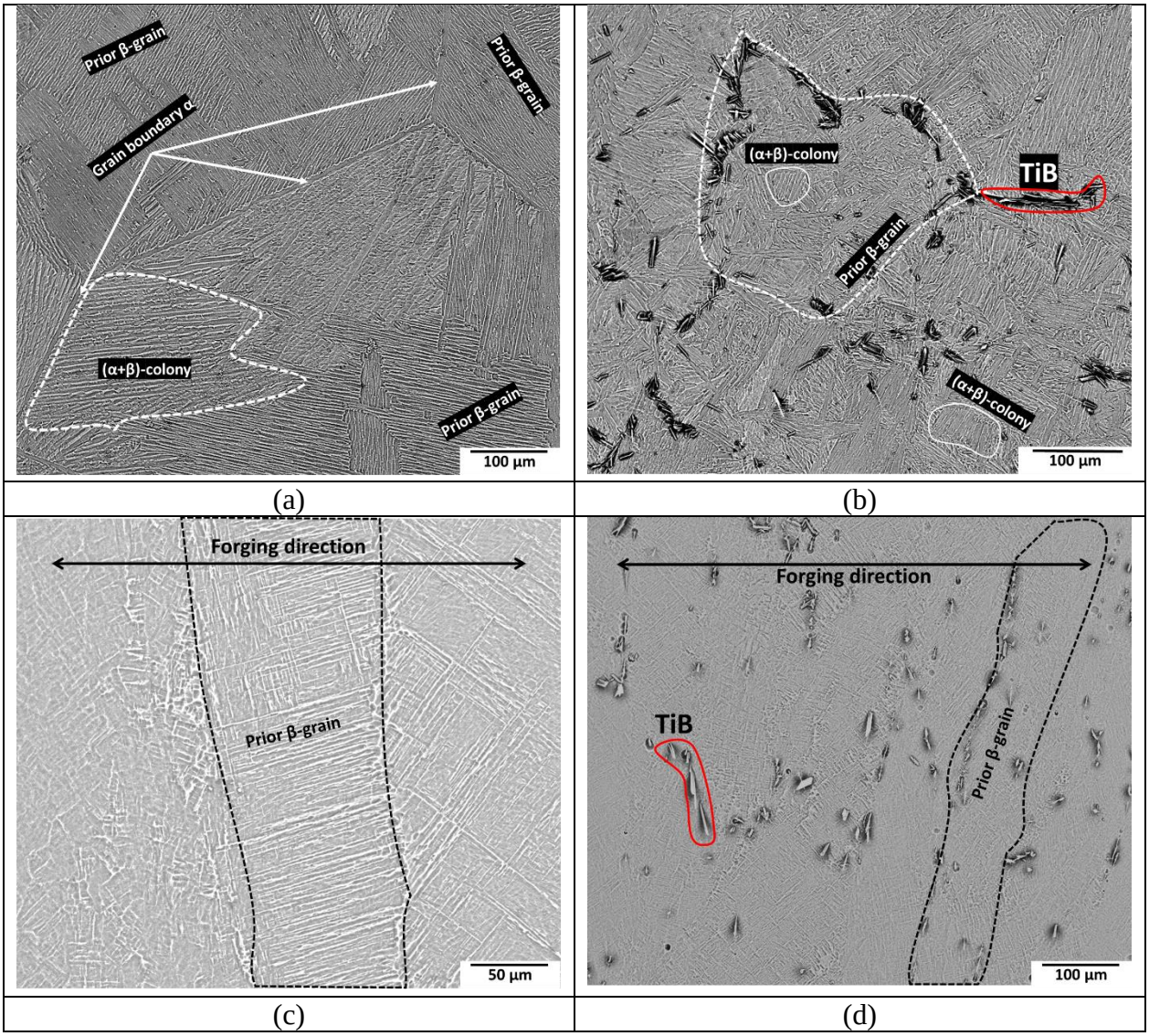
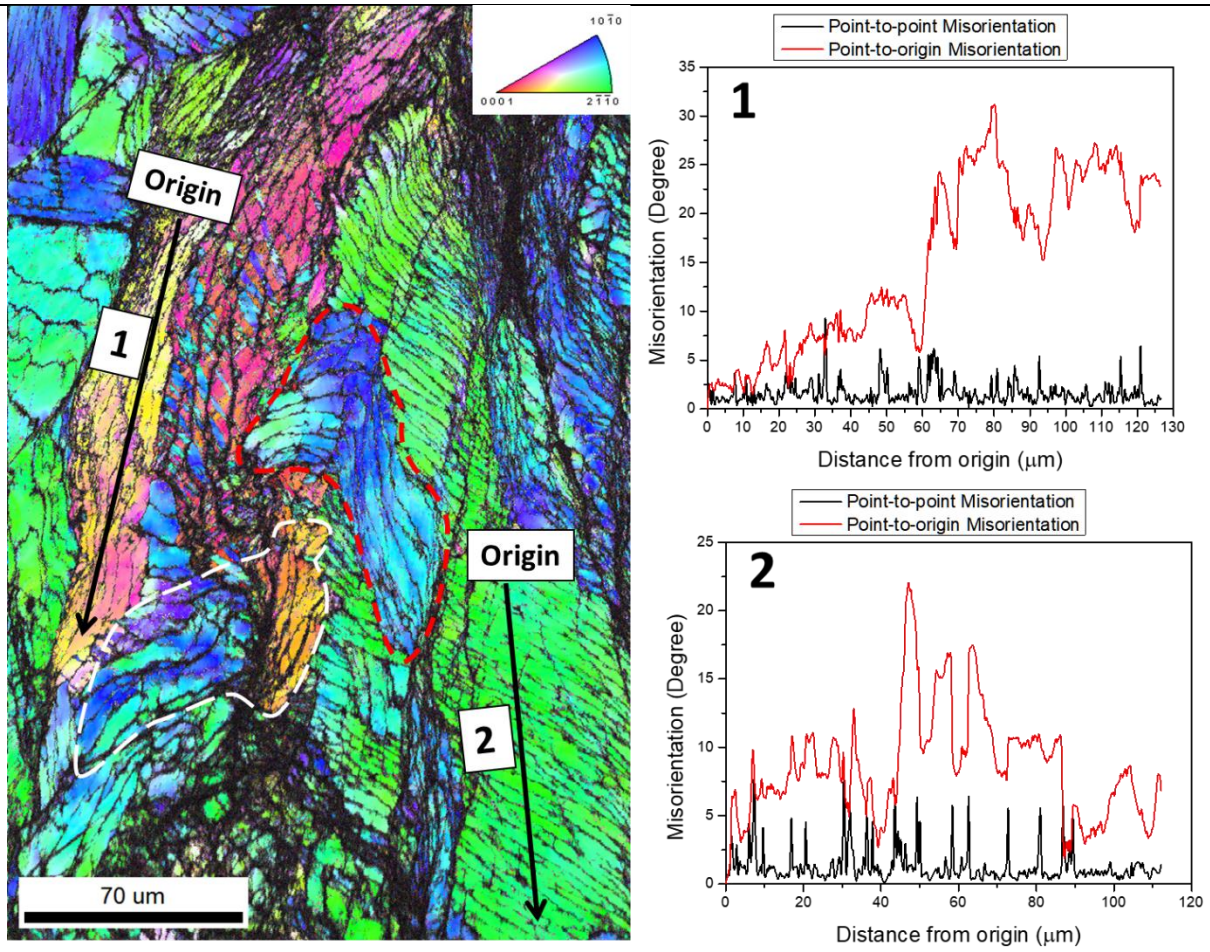
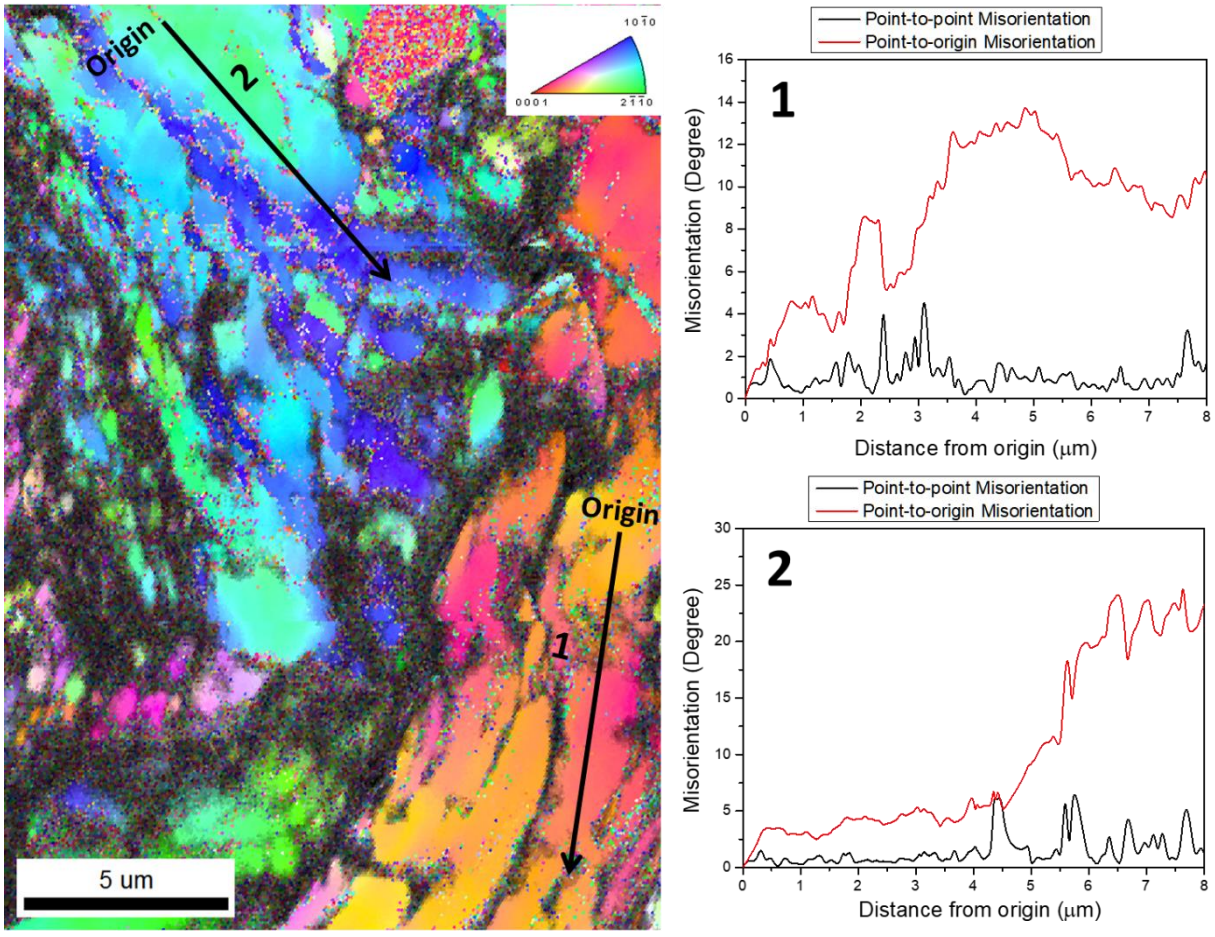


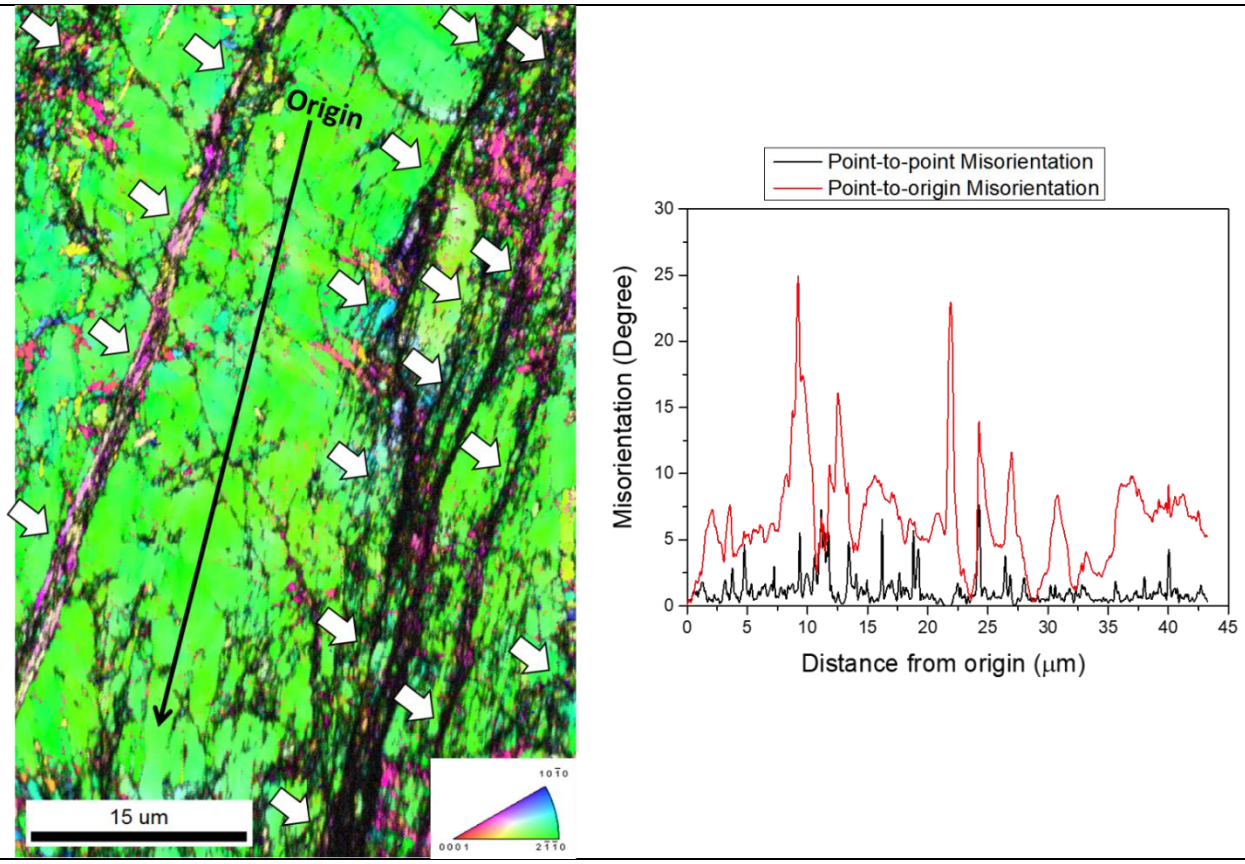
Figure 2: SEM images (BSE mode) showing starting microstructures (before HPT processing) for (a) Ti64-C, (b) Ti64+B-C, (c) Ti64-F and (d) Ti64+B-F alloys.


Origin
1
Origin
2
70 um
Point-to-point Misorientation
Point-to-origin Misorientation
1
Misorientation (Degree)
Distance from origin (μm)
Point-to-point Misorientation
Point-to-origin Misorientation
2
Misorientation (Degree)
Distance from origin (μm)

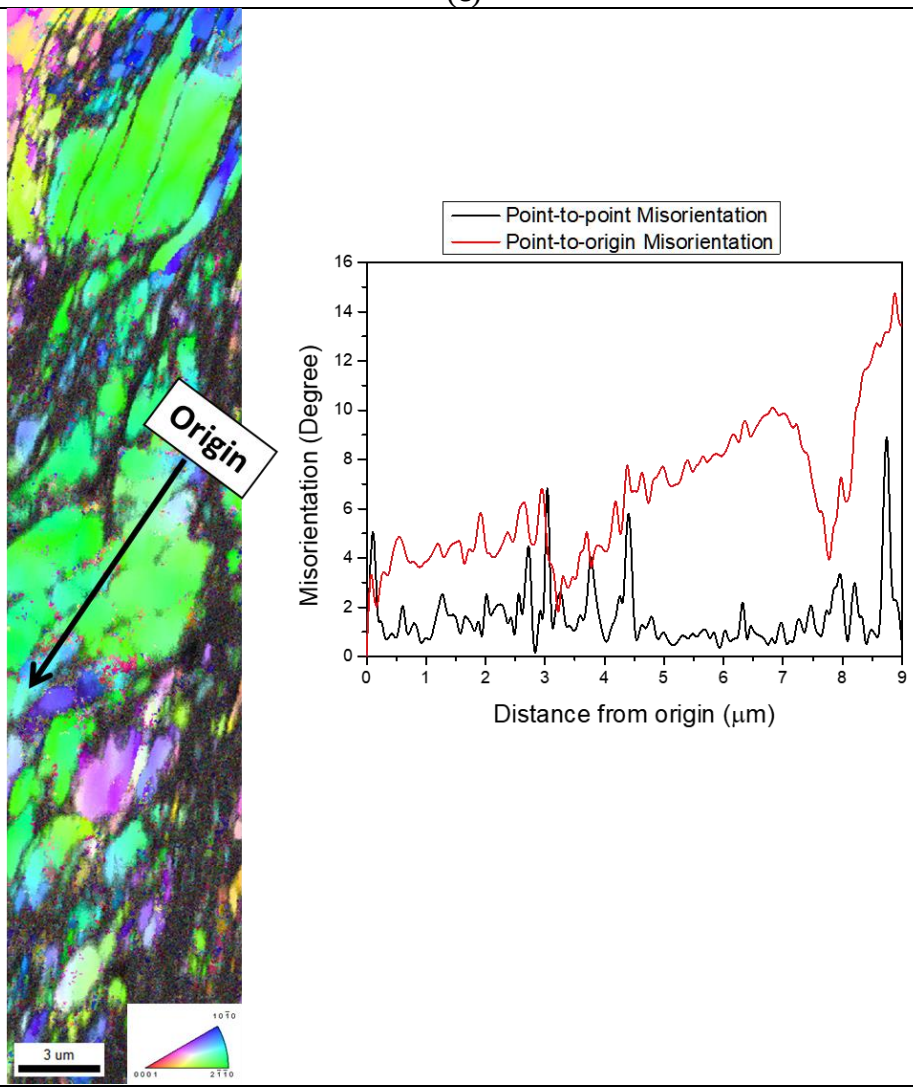
(a)


Origin
2
Origin
1
5 um
Point-to-point Misorientation
Point-to-origin Misorientation
1
Misorientation (Degree)
Distance from origin (μm)
Point-to-point Misorientation
Point-to-origin Misorientation
2
Misorientation (Degree)
Distance from origin (μm)

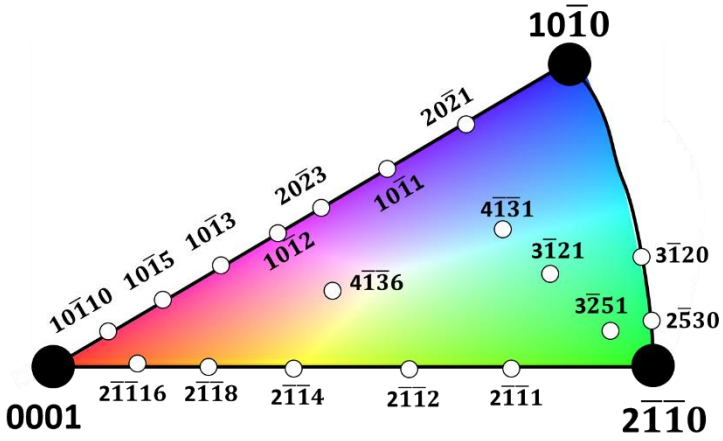
(b)


Origin
15 um
Point-to-point Misorientation
Point-to-origin Misorientation
Misorientation (Degree)
Distance from origin (μm)

(c)

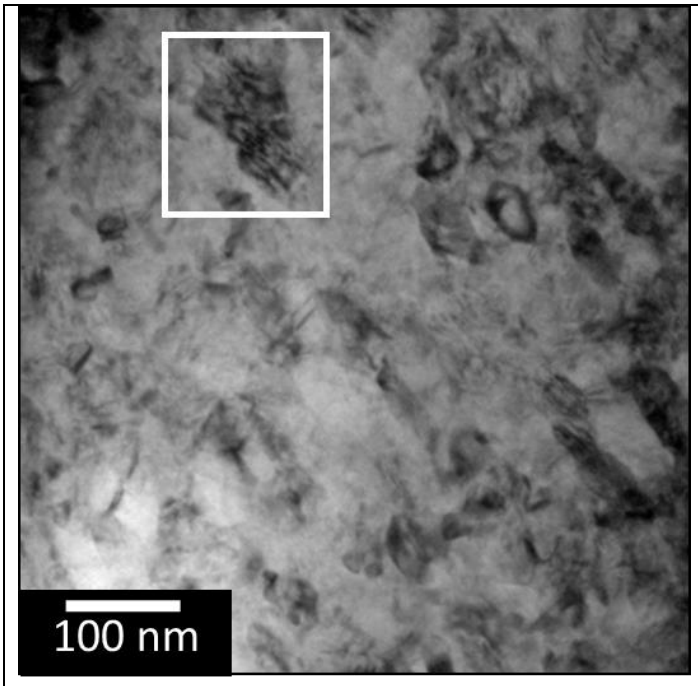

Origin
3 um
Point-to-point Misorientation
Point-to-origin Misorientation
Misorientation (Degree)
Distance from origin (μm)

(d)

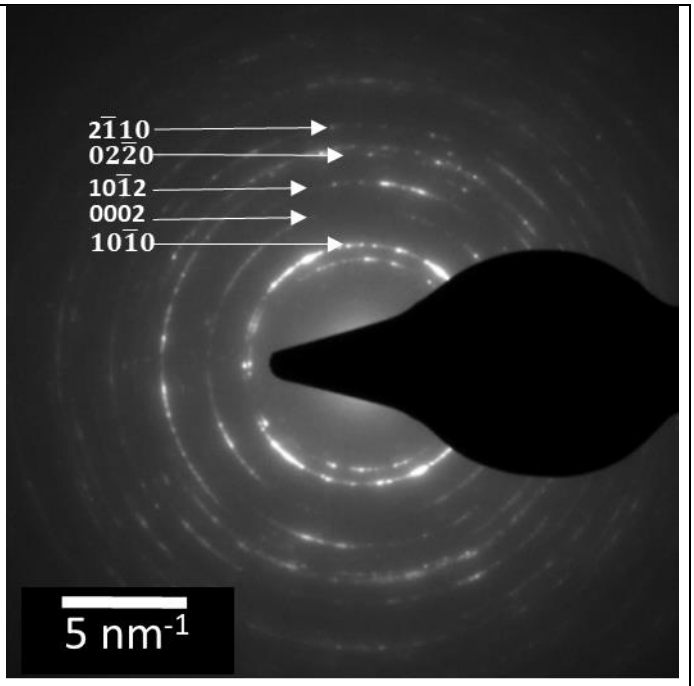


(e)

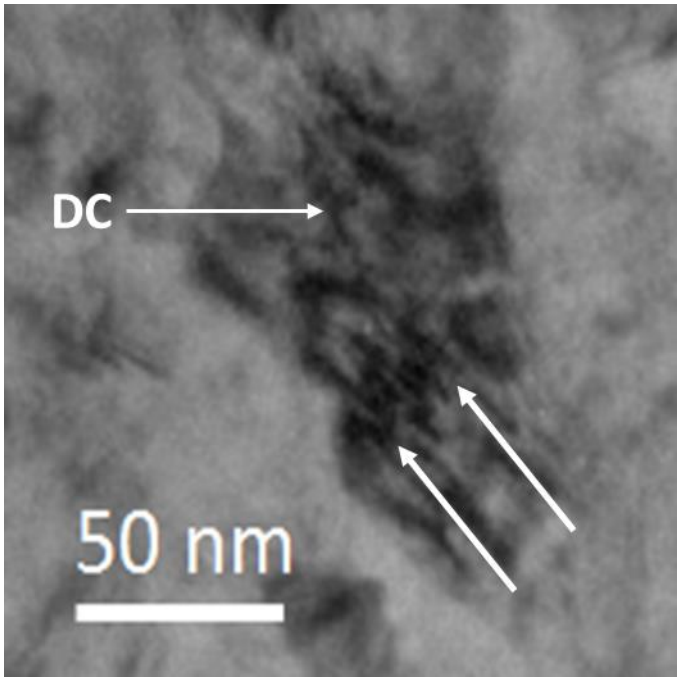
Figure 3: EBSD IPF maps (superimposed with image quality) showing microstructures of (a) Ti64-C, (b) Ti64+B-C, (c) Ti64-F, and (d) Ti64+B-F alloys after one HPT-rotation; (e) showing standard stereographic triangle superimposed with reference color triangle for hcp materials; it thus represents important directions and corresponding reference colors in EBSD IPF maps. Alongside IPF maps, the change in misorientation (on a point-to-point and point-to-origin basis) inside individual α-colonies is also plotted for different alloys.



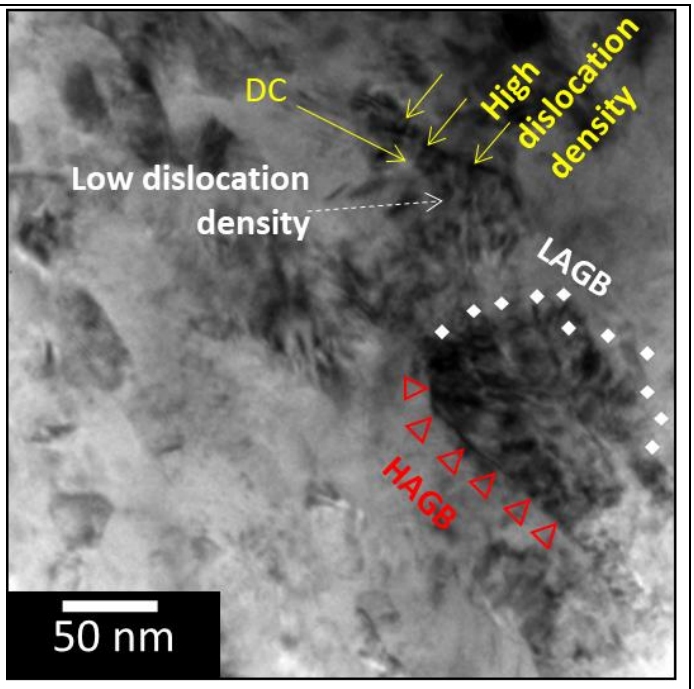
(a)



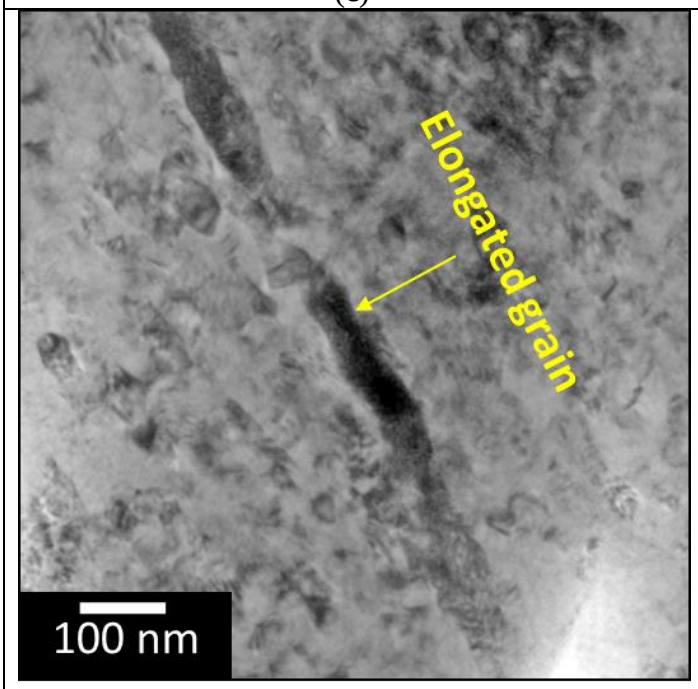
(b)


DC
50 nm

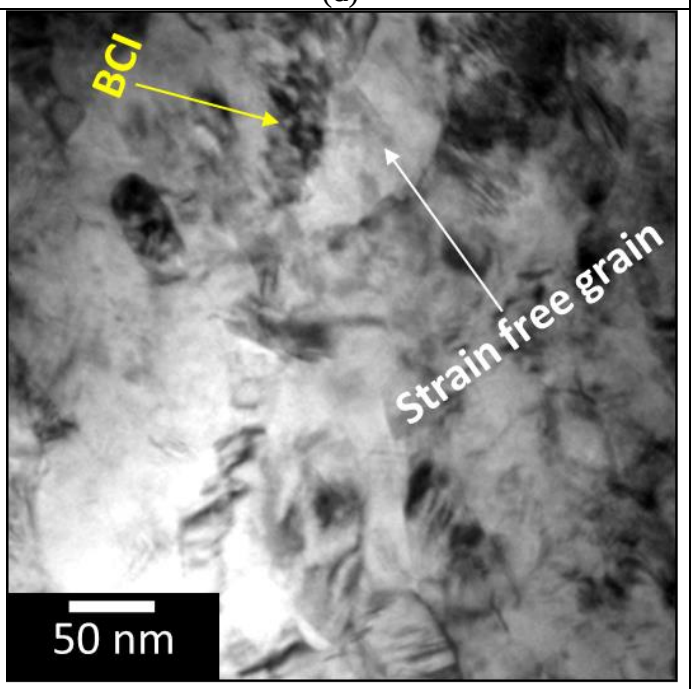
(c)


DC
High dislocation density
Low dislocation density
LAGB
HAGB
50 nm

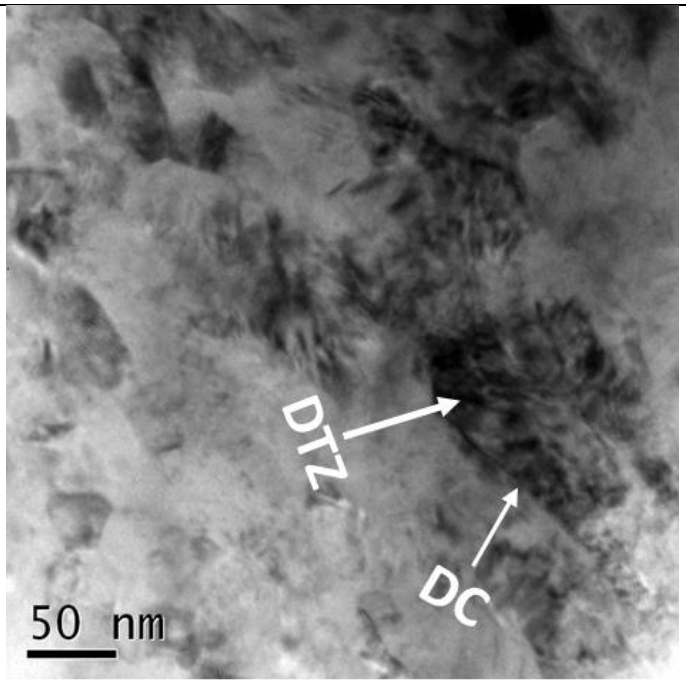
(d)


Elongated grain
100 nm

(e)

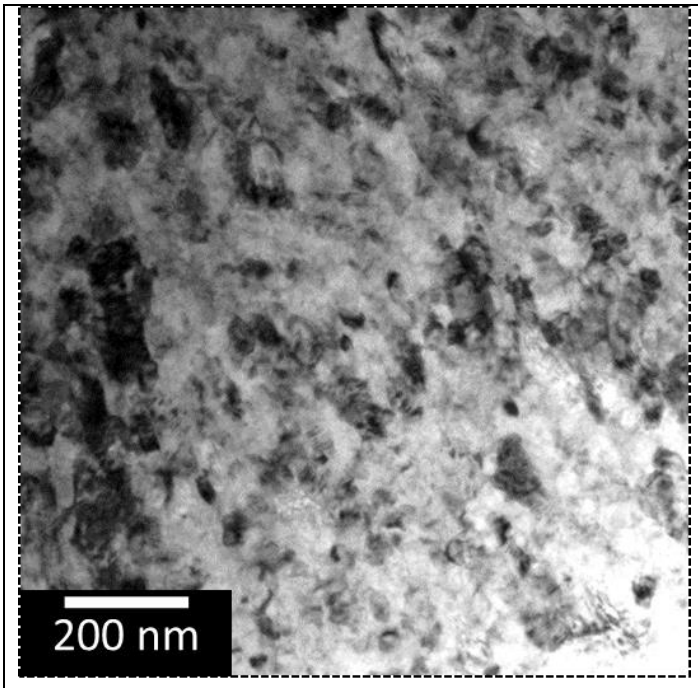

BCI
Strain free grain
50 nm

(f)

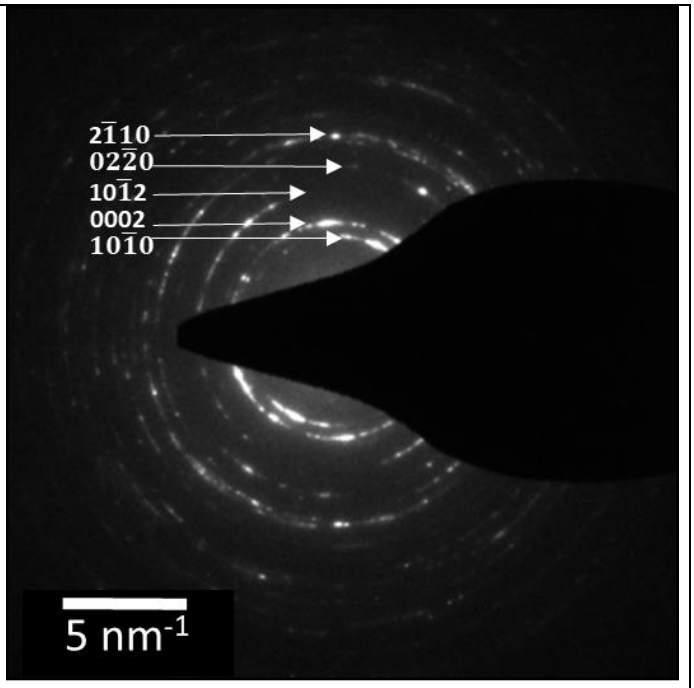


(g)

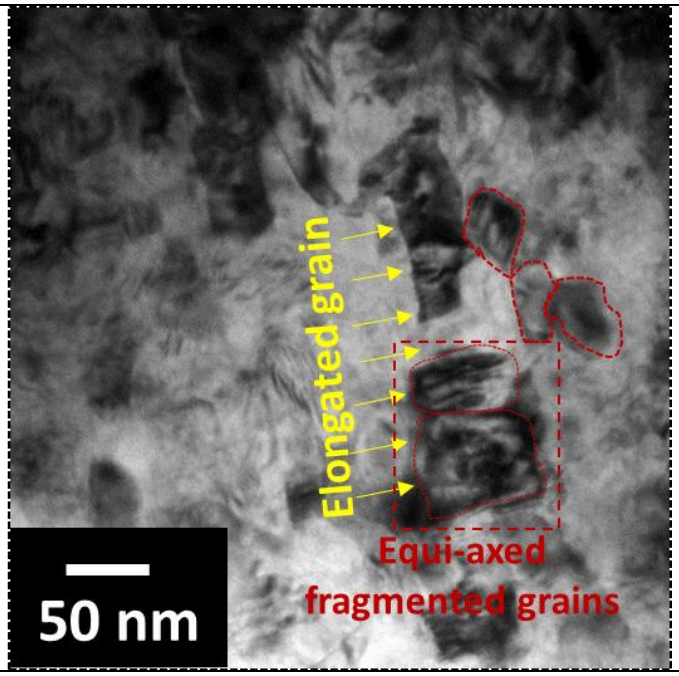
Figure 4: TEM micrographs (brightfield mode) showing (a), (c), (d) microstructure and (b) corresponding SAD pattern for Ti64-C alloy; (e), (f), (g) microstructures for Ti64+B-C alloy after 10 HPT-rotations. Important features and observation areas are marked in these micrographs.



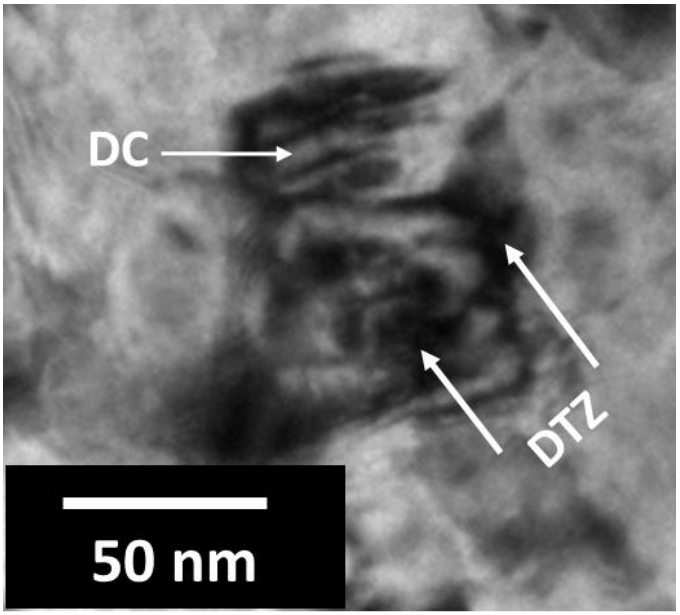
(a)



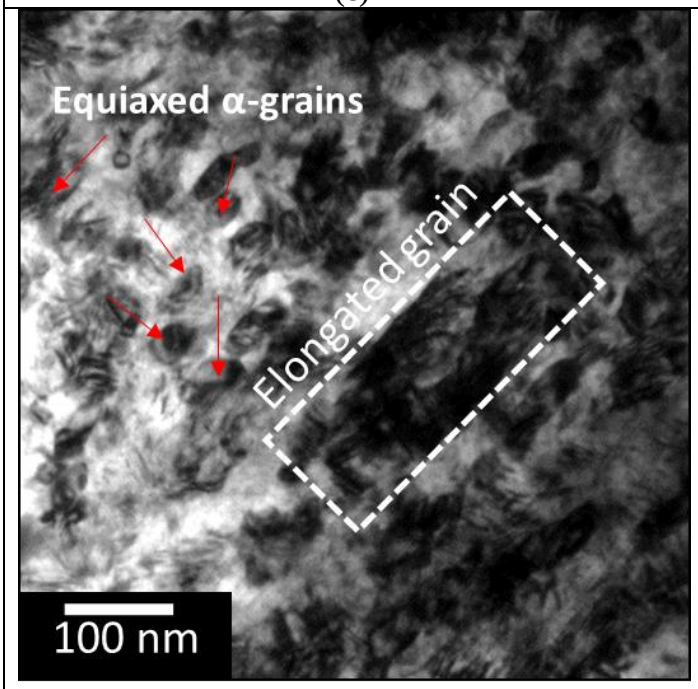
(b)


Elongated grain
Equi-axed
fragmented grains
50 nm

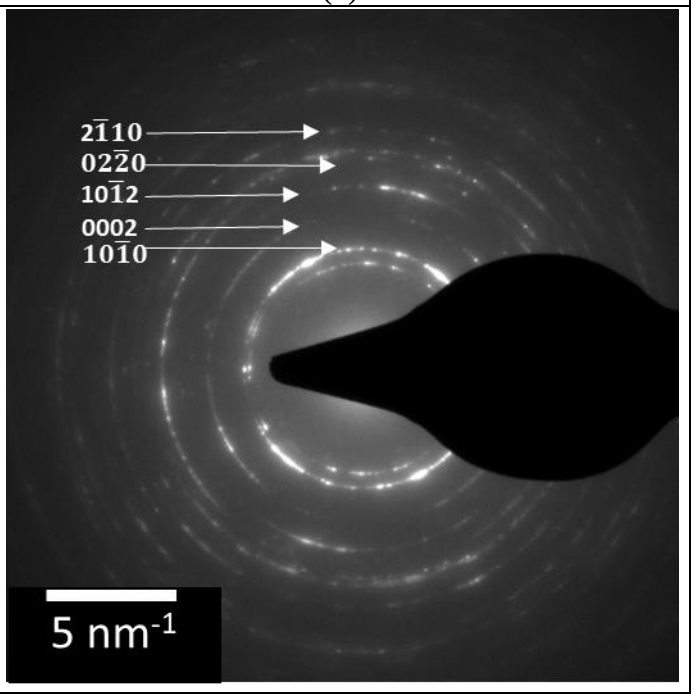
(c)


DC
DTZ
50 nm

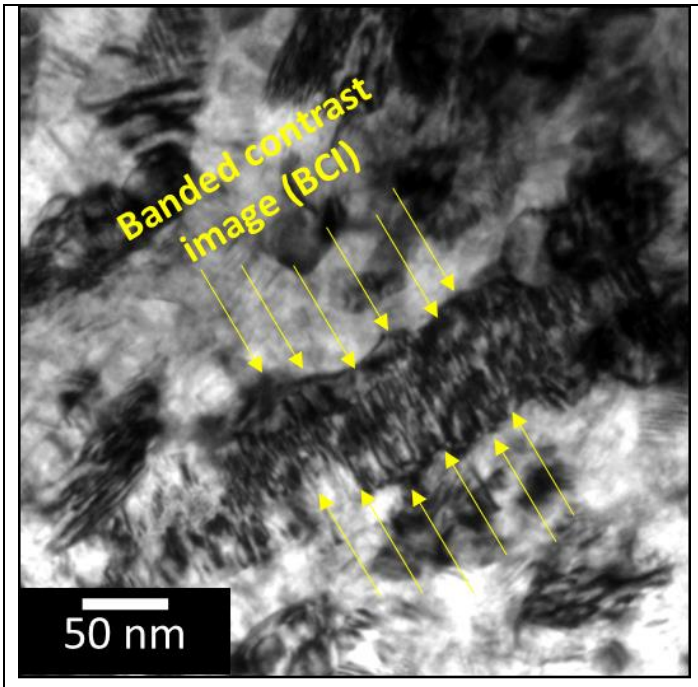
(d)


Equiaxed α-grains
Elongated grain
100 nm

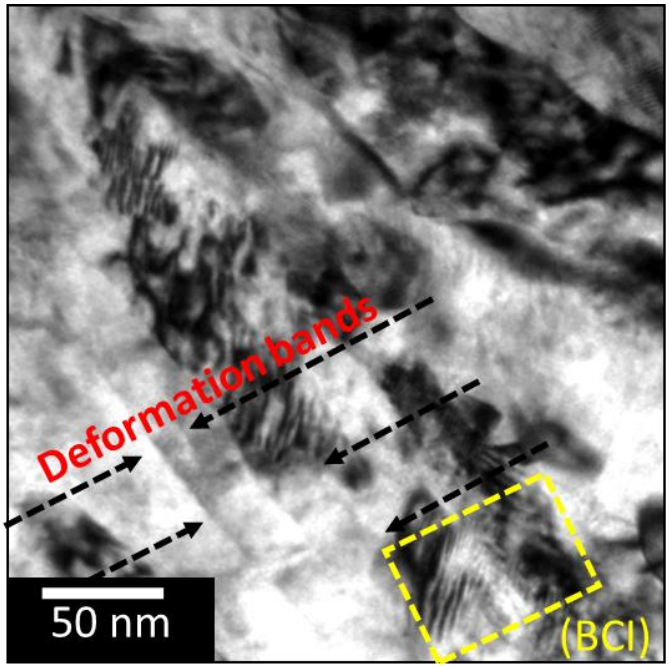
(e)


$2\bar{1}10$
$02\bar{2}0$
$10\bar{1}2$
0002
$10\bar{1}0$
5 nm^{-1}

(f)



(g)



(h)

Figure 5: TEM images (brightfield mode) showing (a), (c), (d) microstructure and (b) SAD pattern for Ti64-F alloy; (e), (g), (h) microstructures and (f) SAD pattern for Ti64+B-F alloy after 10 HPT-rotations. Important features and observation areas are marked in the micrographs.

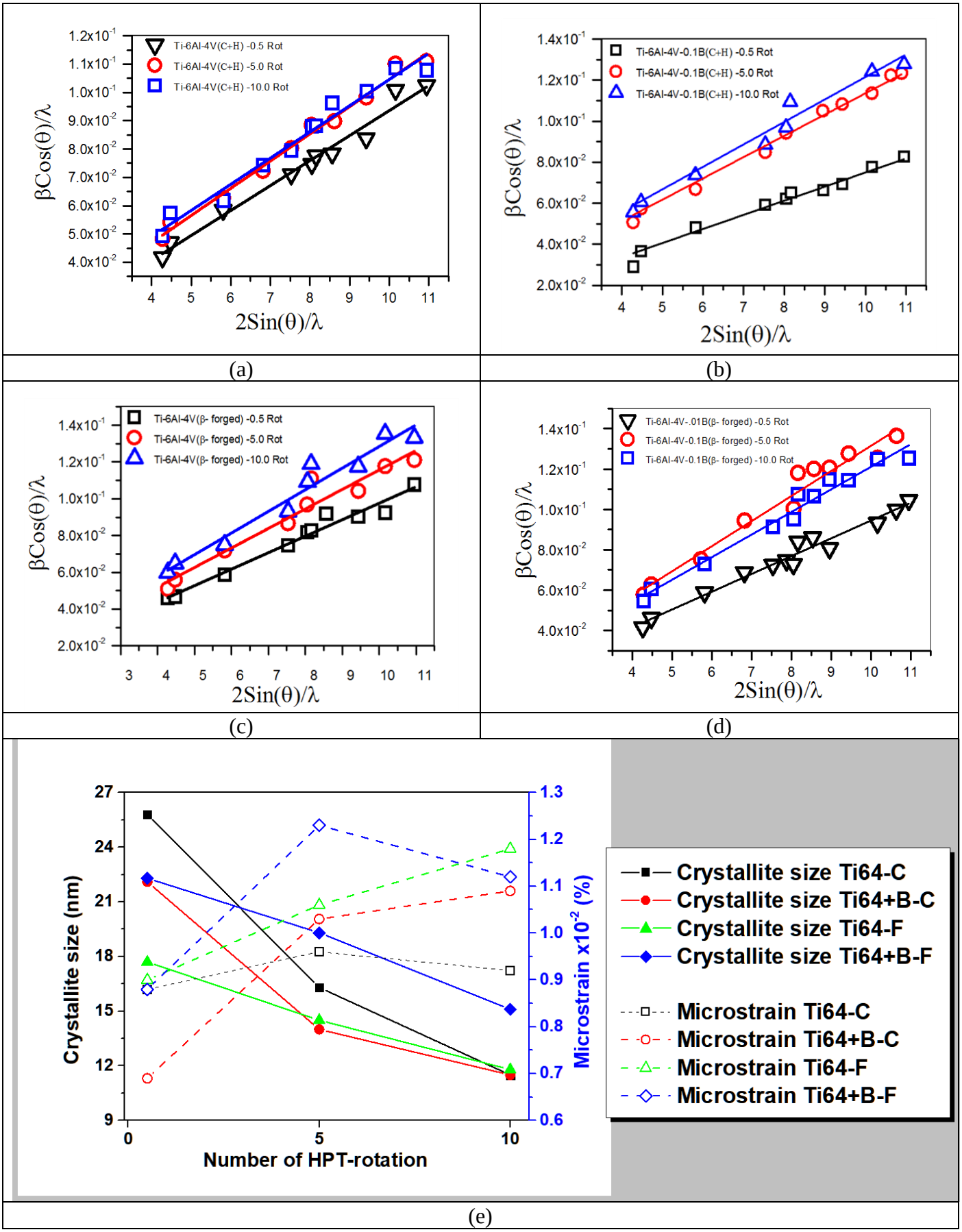


Figure 6: Classical Williamson-Hall plot showing the variation in FWHM with HPT-rotations for (a), (b) Ti64-C and Ti64+B-C alloys, respectively in as-cast condition and (c), (d) Ti64-F and Ti64+B-F alloys, respectively in β-forged condition; (e) variation in crystallite size and micro-strain calculated from W-H analysis with HPT-rotations for different alloys and conditions.

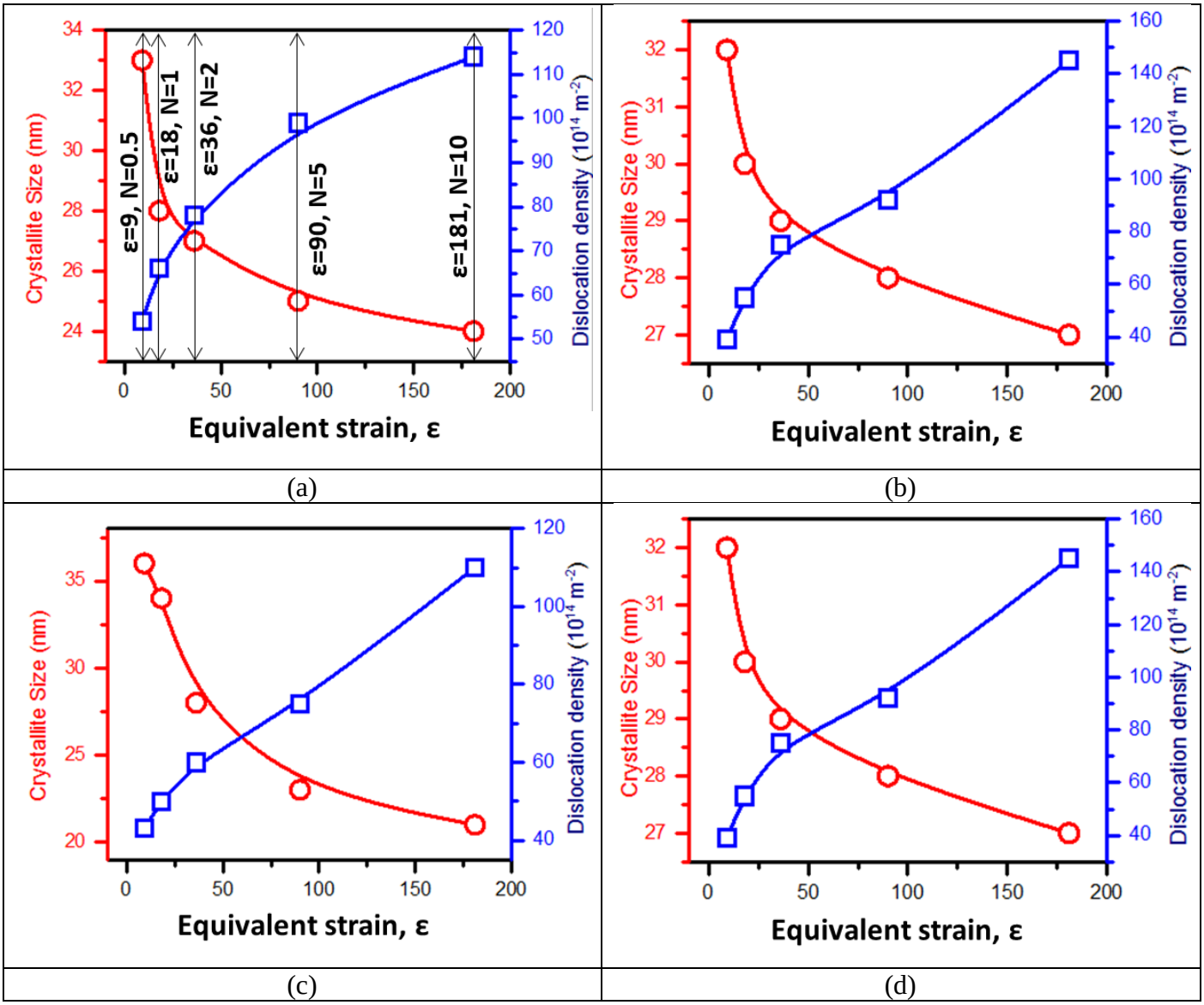


Figure 7: Variation in crystallite size and dislocation density with equivalent strain calculated from CMWP method for (a), (b) Ti64-C and Ti64+B-C alloys, respectively and (c), (d) Ti64-F and Ti64+B-F alloys, respectively. The equivalent strain, ε corresponding to various HPT-rotations are mentioned in (a).

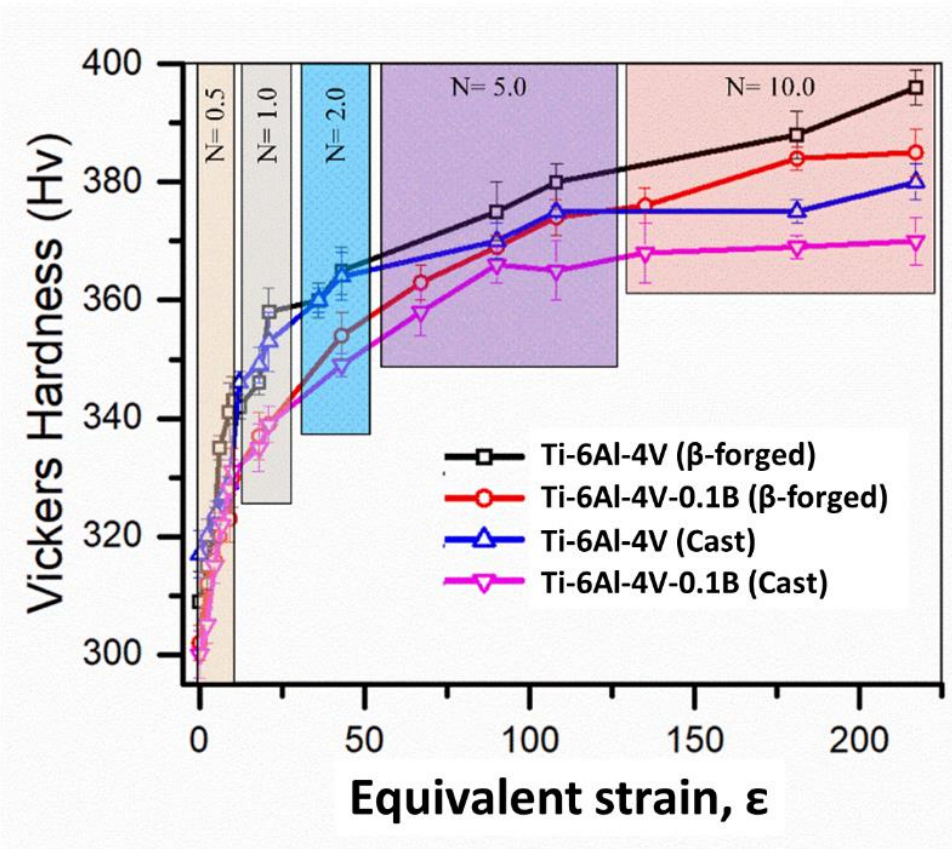


Figure 8: Hardness variation with equivalent strain for the alloys (unmodified and Boron modified) in different conditions (as-cast and β-forged).

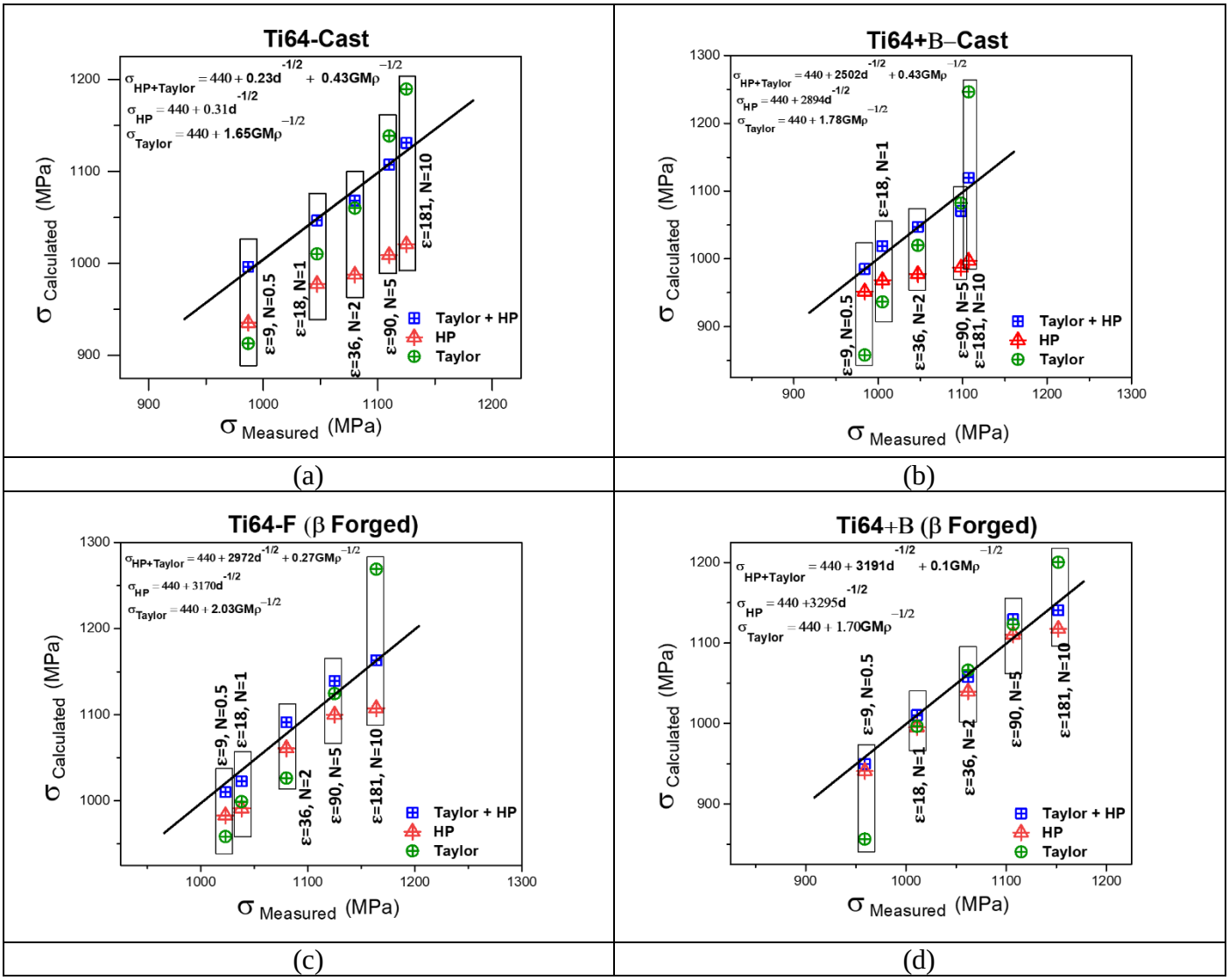


Figure 9: $\sigma_{measured}$ vs. $\sigma_{calculated}$ plots represent the contributions from various strengthening mechanisms towards strength increment (a) Ti64-C, (b) Ti64+B-C, (c) Ti64-F and (d) Ti64+B-F alloys.