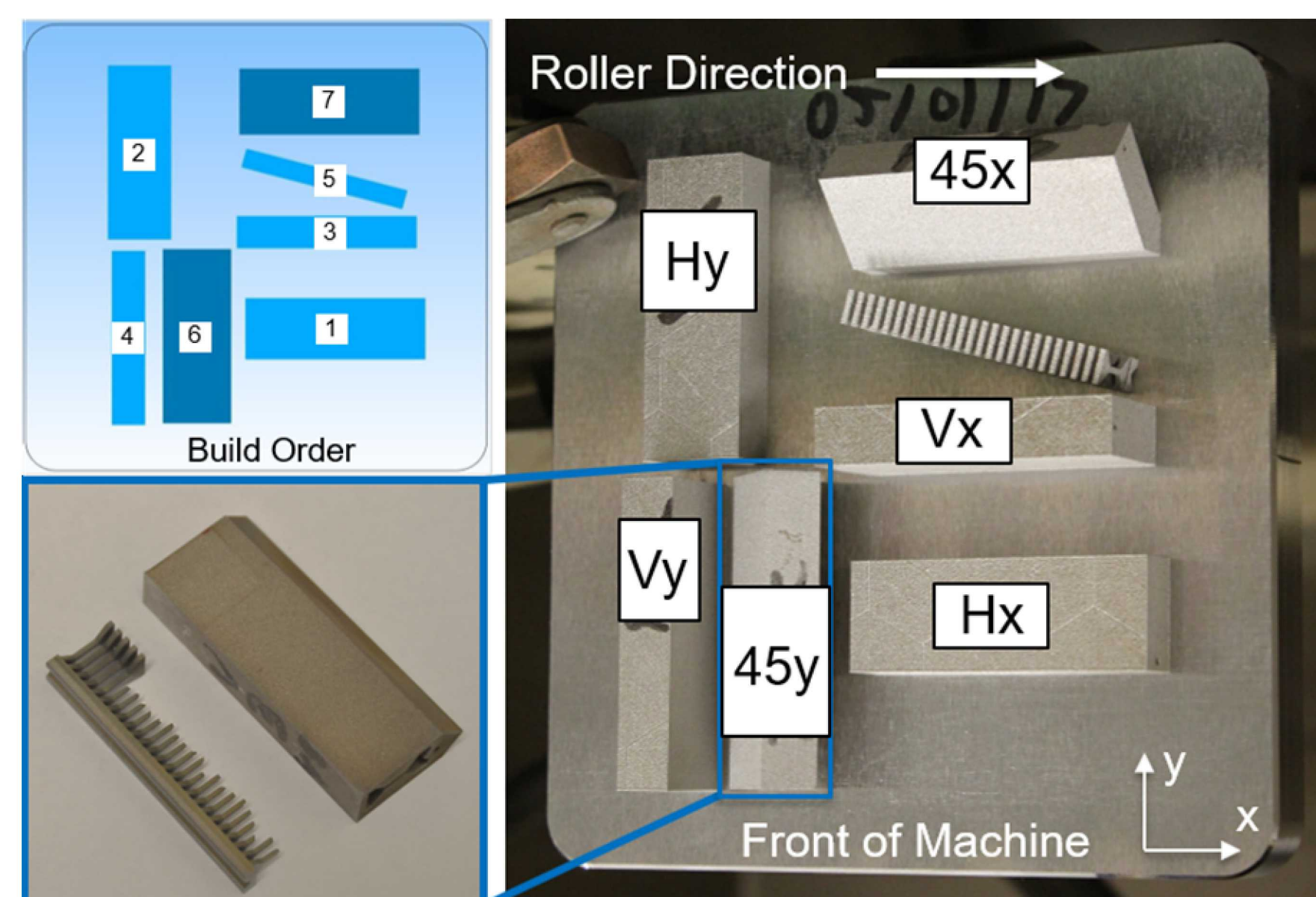
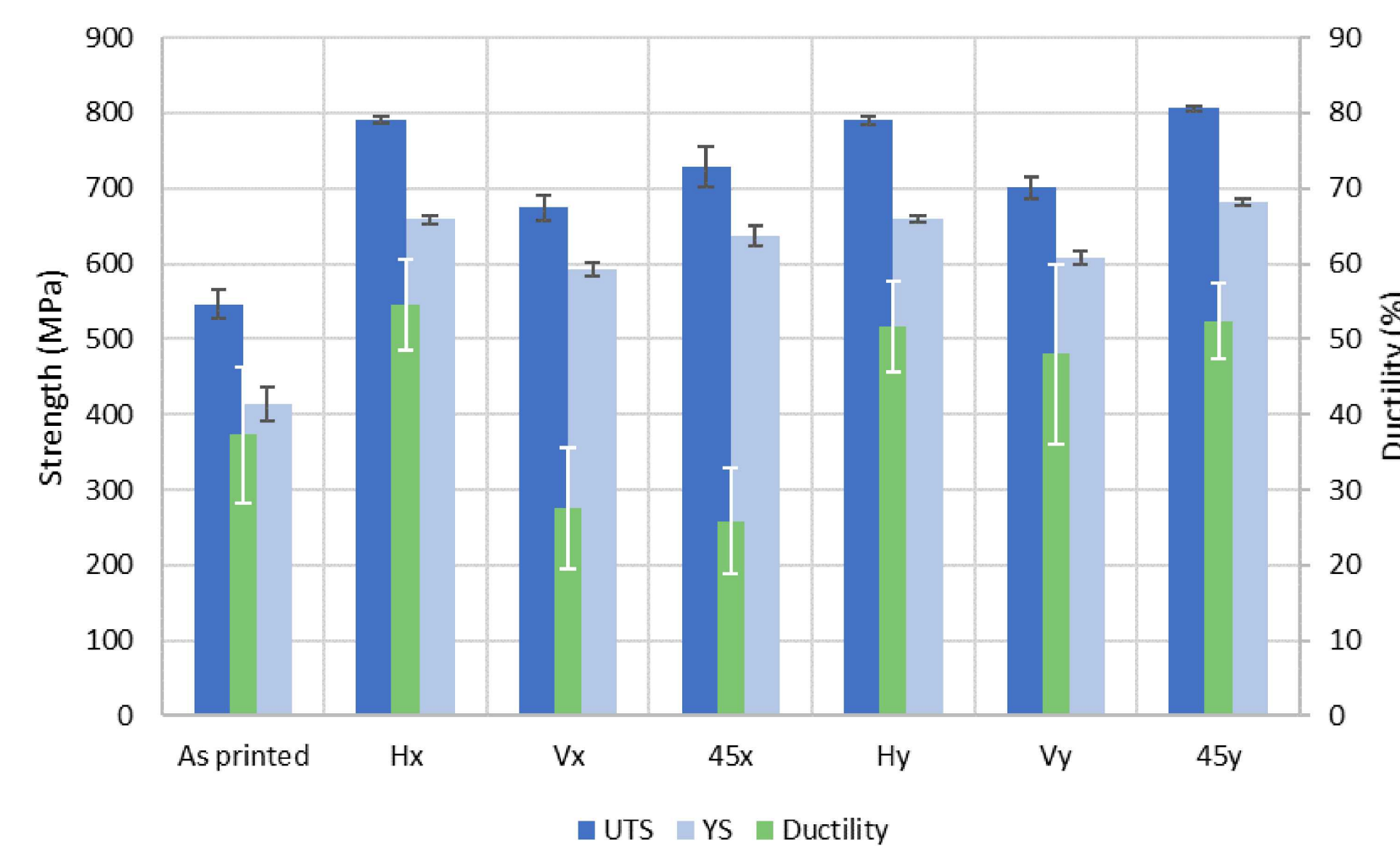


316L AM Part Failure: Effect of Post Machining and Build Orientation

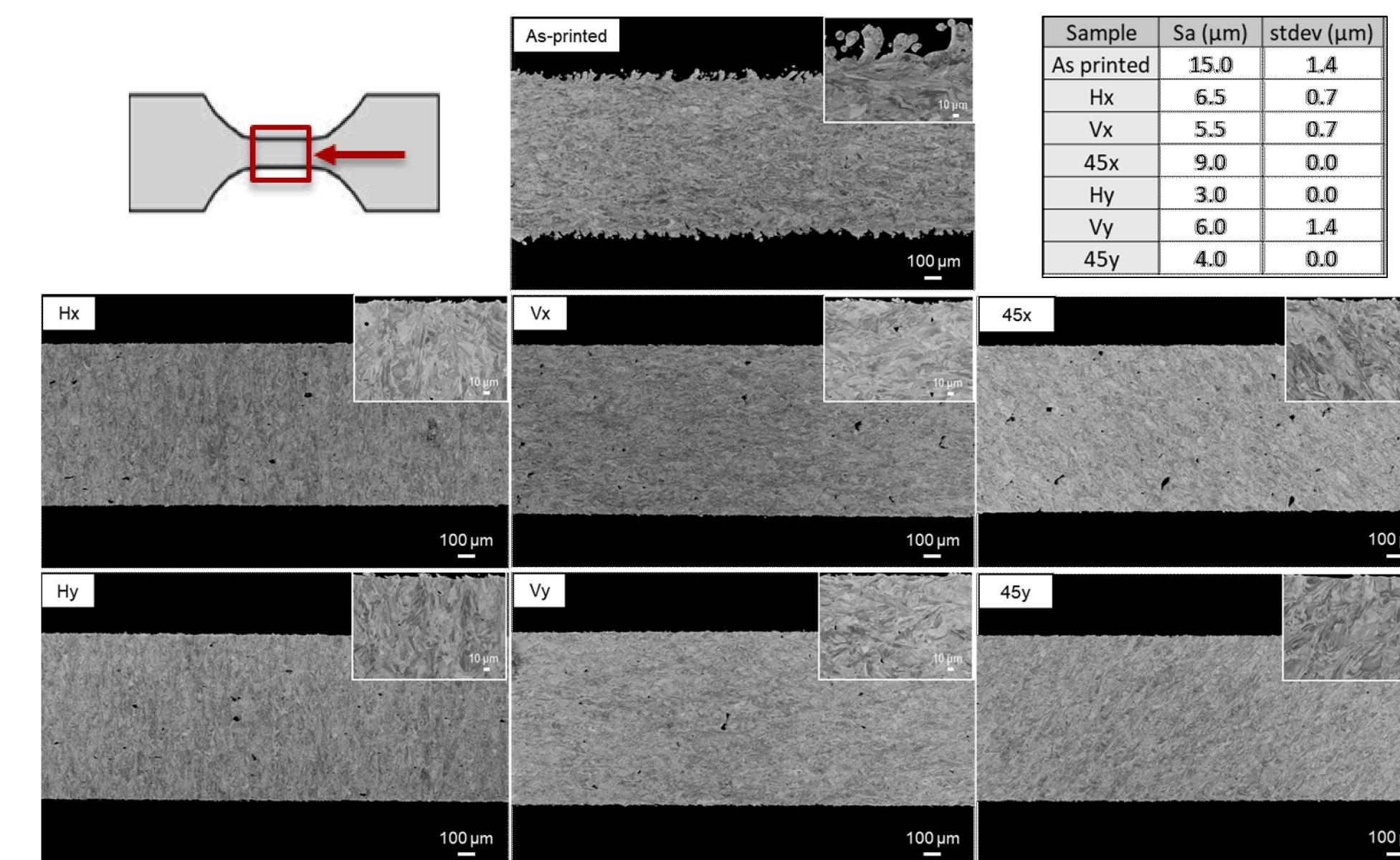
Michael Heiden, David Saiz, Dan Tung, David Moore, Bradley Jared



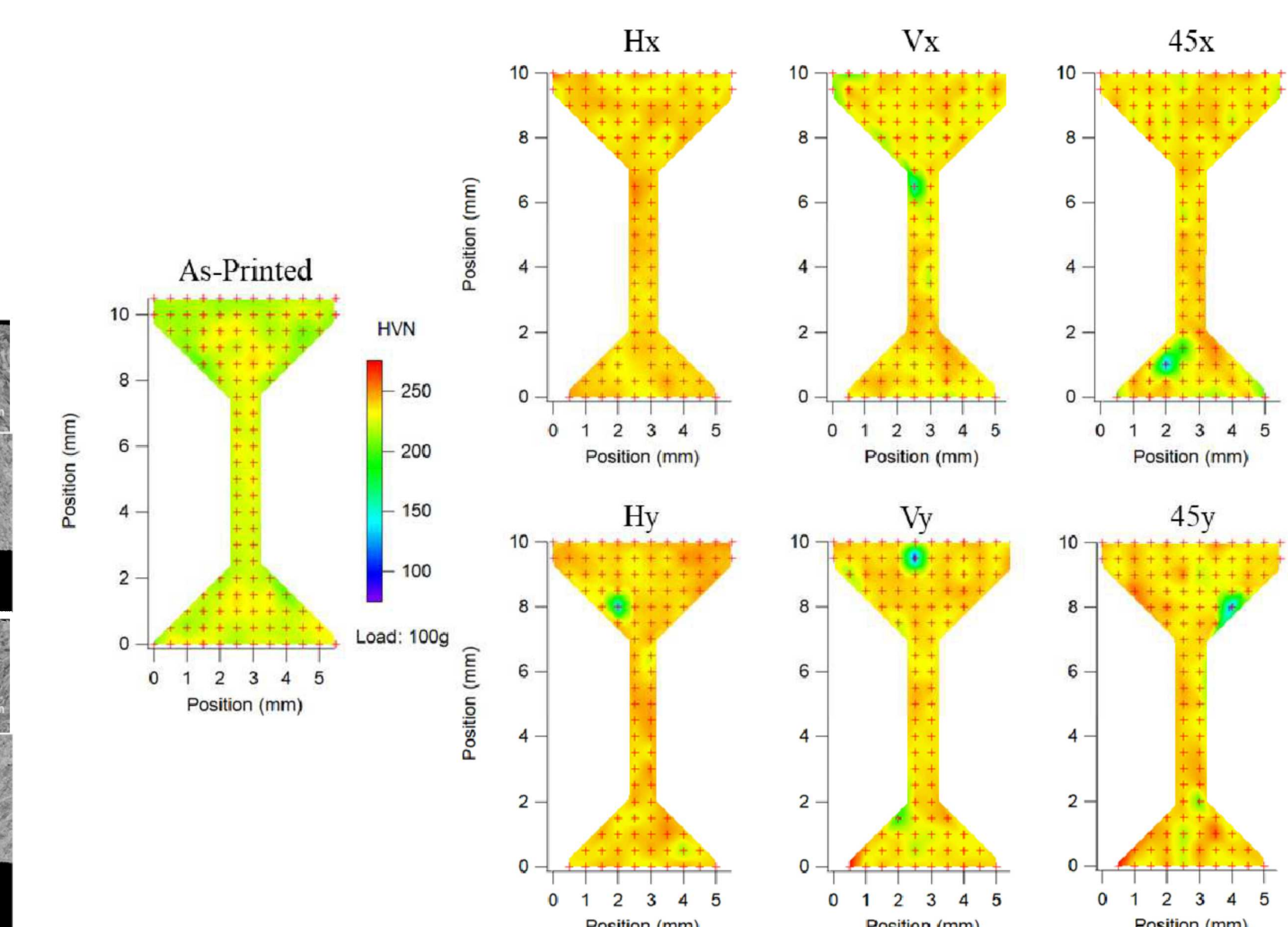
316L AM blocks built in as-printed state and μ-EDM into HTT tensile bars in various orientations



Mechanical properties for 316L stainless steel built Horizontal, Vertical, & 45°, in the x and y directions.



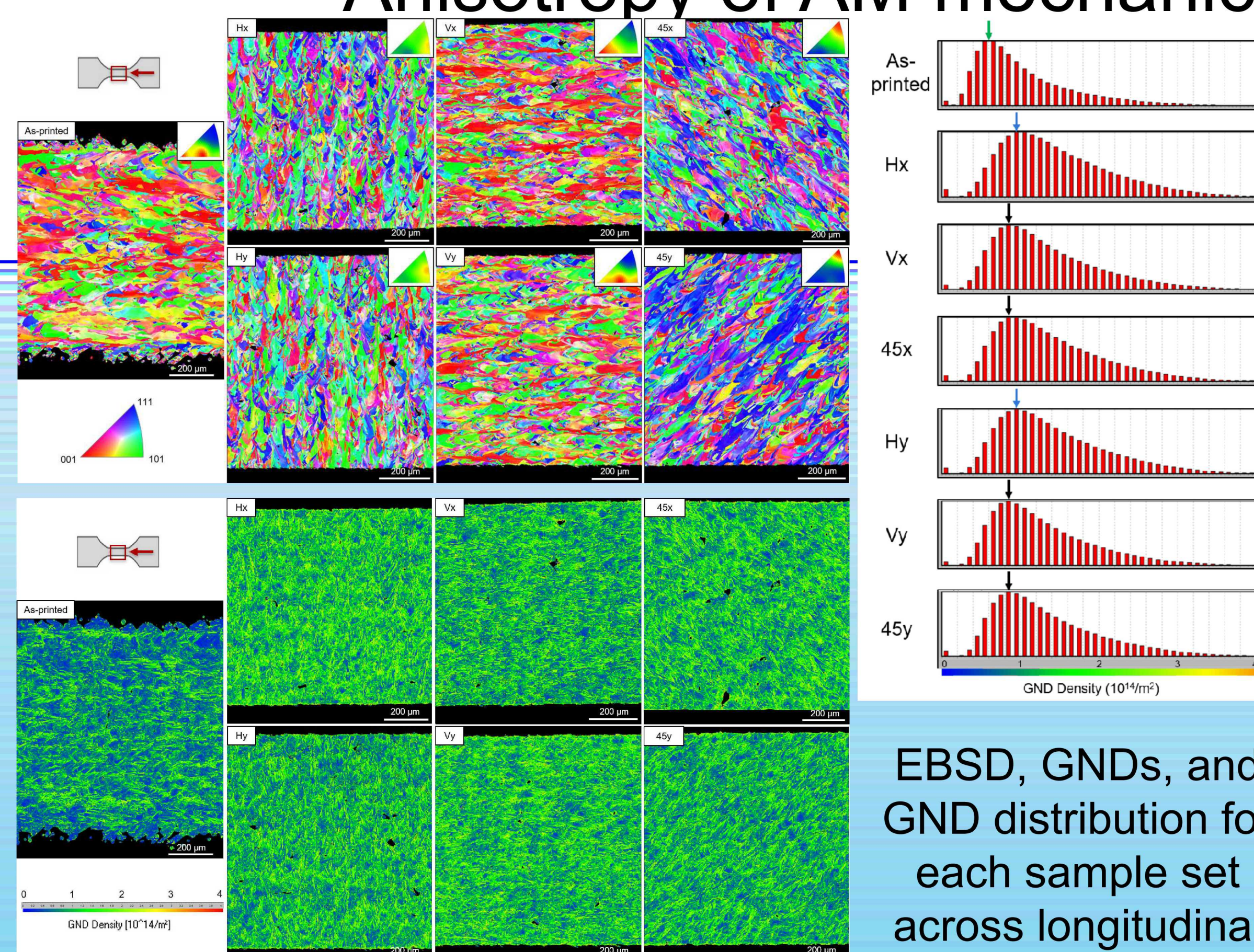
SEM of cross sections across the longitudinal axis. As-printed crust layer is ~ 60 μm thick. EDM is ~ 4-10 μm.



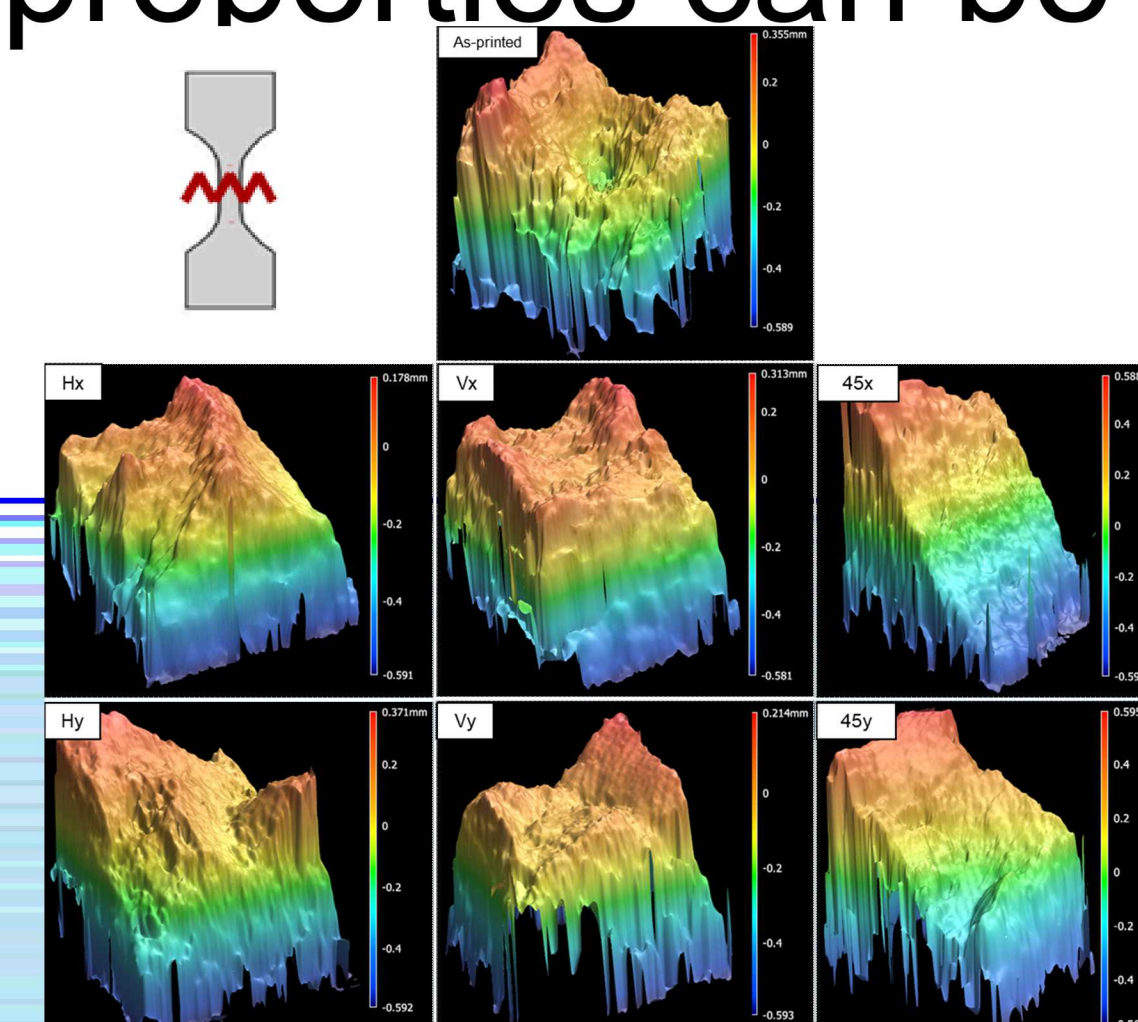
Vickers hardness maps of tensile sample cross sections across the longitudinal axis

- Concentration and orientation of large ($> 0.001 \text{ mm}^3$) elongated pores play dominant role in directing AM part failure

- Anisotropy of AM mechanical properties can be greatly affected by build angle and location on plate

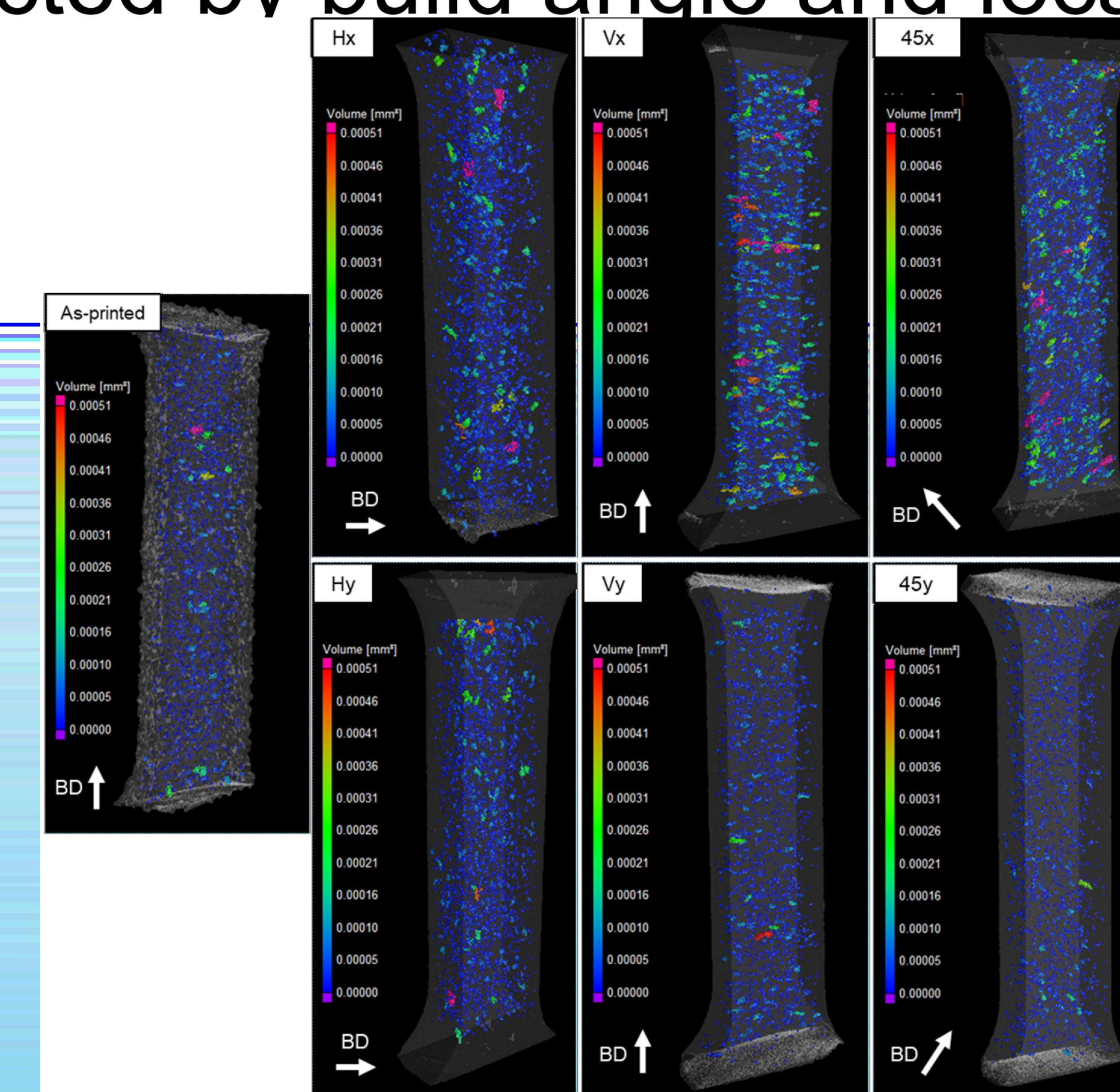


EBSD, GNDs, and GND distribution for each sample set across longitudinal axis

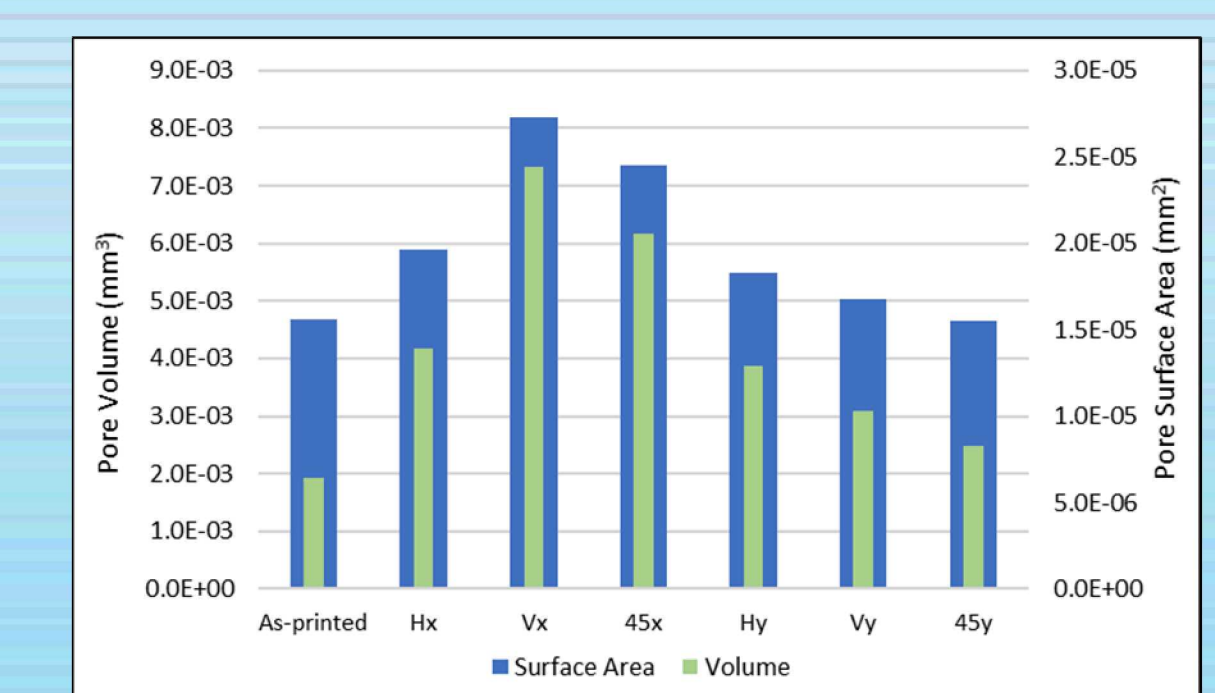
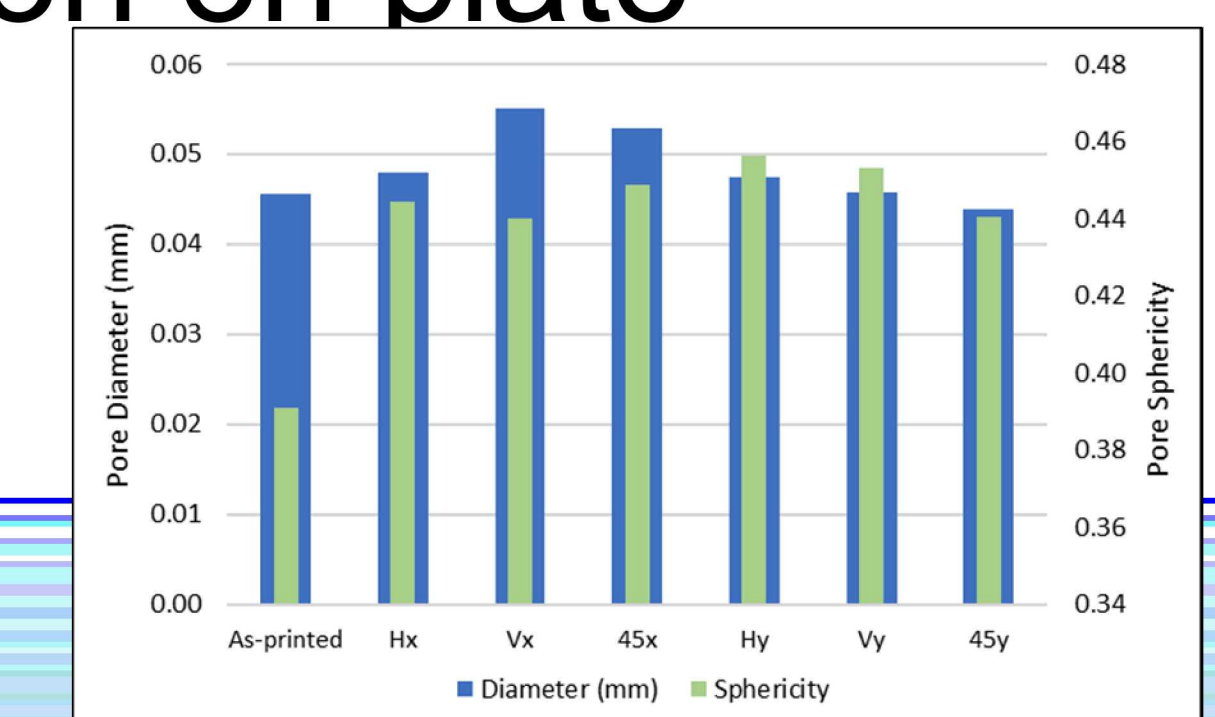


Keyence fracture surfaces of tensile samples post-tension testing

Sample	UTS (MPa)	YS (MPa)	Ductility (%)	Density (g/mm ³)	Sa (μm)	Grain Size (μm)	Grain Aspect Ratio	Number of pores (#)
As printed	546 (19)	414 (22)	37 (9)	7.87	15.0 (1.4)	10.7 (10.3)	3.4 (2.4)	2459
Hx	791 (5)	658 (6)	54 (6)	7.94	6.5 (0.7)	9.8 (7.7)	3.4 (2.2)	3191
Vx	674 (16)	592 (9)	28 (8)	7.92	5.5 (0.7)	10.2 (8.6)	3.5 (2.3)	3129
45x	728 (27)	636 (13)	26 (7)	7.90	9.0 (0.0)	10.4 (8.9)	3.5 (2.2)	4381
Hy	790 (5)	659 (4)	52 (6)	7.92	3.0 (0.0)	10.0 (8.3)	3.7 (2.5)	3178
Vy	701 (15)	607 (9)	48 (12)	7.93	6.0 (1.4)	10.8 (9.1)	3.7 (2.5)	2488
45y	806 (4)	682 (5)	52 (5)	7.94	4.0 (0.0)	10.4 (8.9)	3.5 (2.2)	2515



μ-CT images of samples across longitudinal axis



Pore diameter, sphericity, volume, and surface area from μ-CT scans of tensile samples

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