

## Supplementary material

### Silicon mediated twin formation in laser direct energy deposited 316L stainless steel

Kewei Chen<sup>a</sup>, Juan Guillermo Santos Macías<sup>a,1</sup>, Nathalie Isac<sup>a</sup>, Maxime Vallet<sup>b, c</sup>, Louis Cornet<sup>b</sup>, Manas V. Upadhyay<sup>a, \*</sup>

<sup>a</sup> *Laboratoire de Mécanique des Solides (LMS), Ecole Polytechnique, Institut Polytechnique de Paris, CNRS UMR 7649, Palaiseau 91128, France*

<sup>b</sup> *Université Paris-Saclay, CentraleSupélec, ENS Paris-Saclay, CNRS, LMPS - Laboratoire de Mécanique Paris-Saclay, 91190 Gif-sur-Yvette, France*

<sup>c</sup> *Université Paris-Saclay, CentraleSupélec, CNRS, Laboratoire SPMS - Structures, Propriétés et Modélisation des Solides, 91190 Gif-sur-Yvette, France*

\*Corresponding author: [manas.upadhyay@polytechnique.edu](mailto:manas.upadhyay@polytechnique.edu)

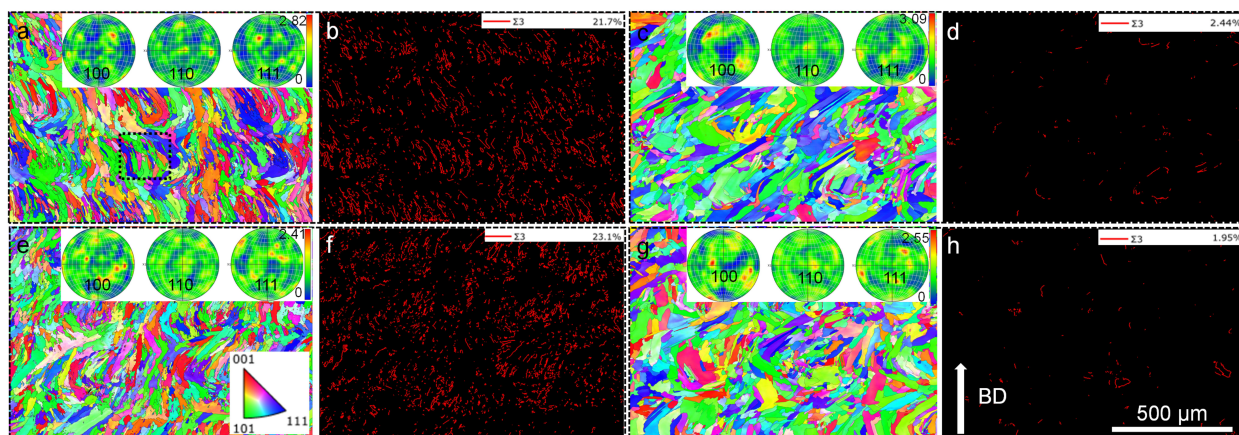


Figure S1. (a, c, e and g) EBSD IPFs along building direction and (b, d, f and h)  $\Sigma 3$  twin boundary maps of as-built (a-b and e-f) 316L-Si and (c-d and g-h) 316L samples, in which (a-d) and (e-h) are the areas from middle and bottom of polished surface, respectively. PFs and length fractions of  $\Sigma 3$  twin boundaries are inserted. The scaler bar for (a-h) is shown in (h).

<sup>1</sup> Current address: IMDEA materials institute, Eric Kandel 2, Technogetafe-Getafe 28906, Spain

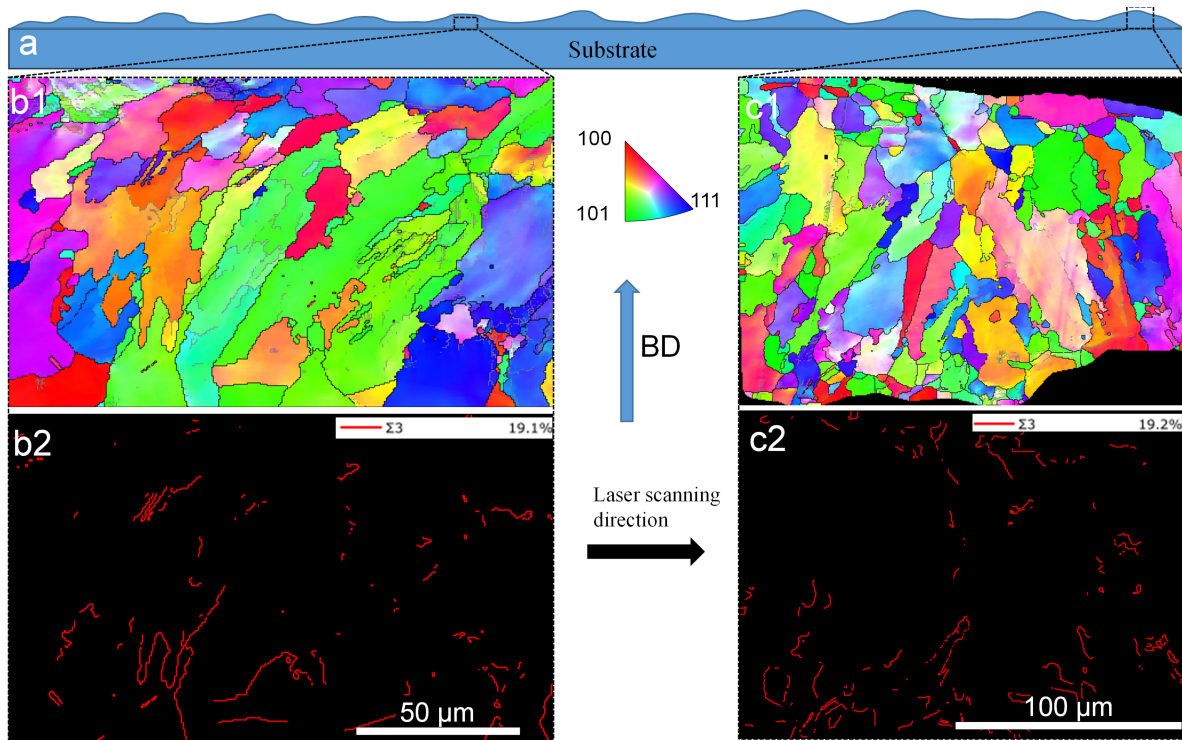


Figure S2. Schematic (a) of L-DED printed single line; (b1 and c1) EBSD IPF and (b2 and c2)  $\Sigma 3$  twin boundary maps of middle and end section of the line.

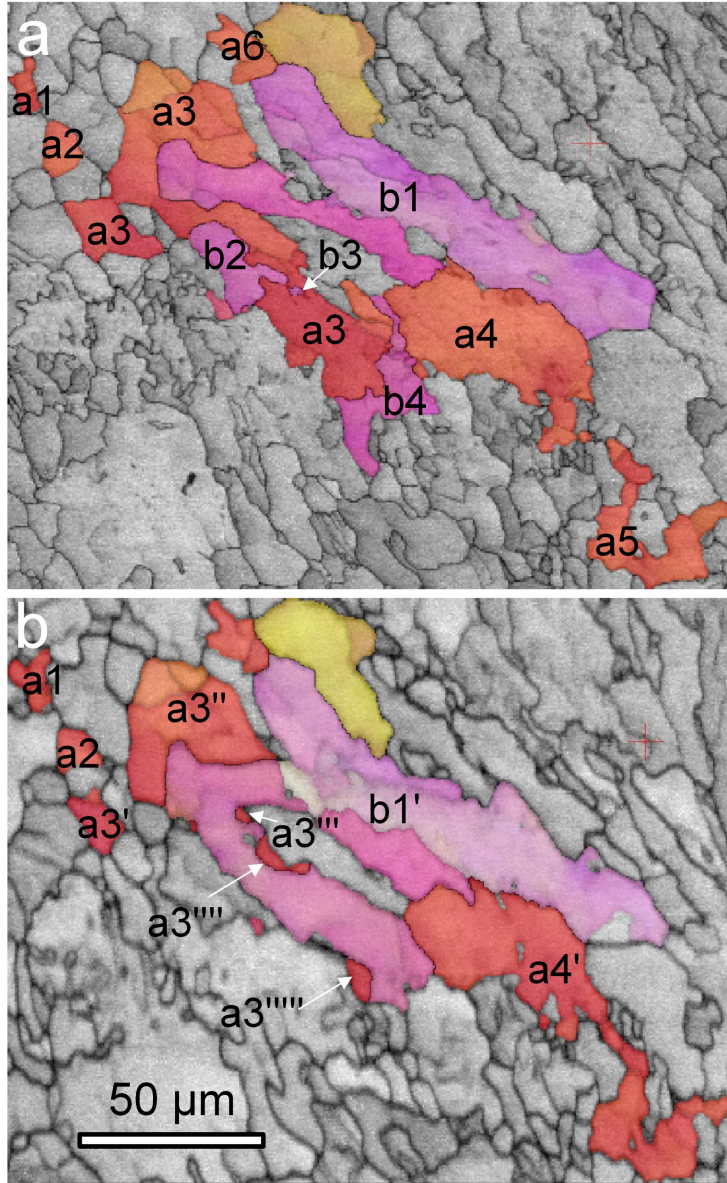


Figure S3. EBSD IPF maps of grains (a) before and (b) after surface removal with thickness of 5  $\mu\text{m}$  in 316L-Si sample.

Grains a1-6 and Grains b1-4 in Figure S3a possess similar orientations. After surface removal with thickness of 5  $\mu\text{m}$ , Grain a3 is divided into Grains a3', a3'', a3''', a3'''' and a3''''', Grains a4-5 merge into Grain a4', and Grains b1-4 merge into b1', as shown in Figure S3b. Therefore, the dashed grains are entangled with each other in 316L-Si samples, which can increase the resistance of crack propagation during deformation.



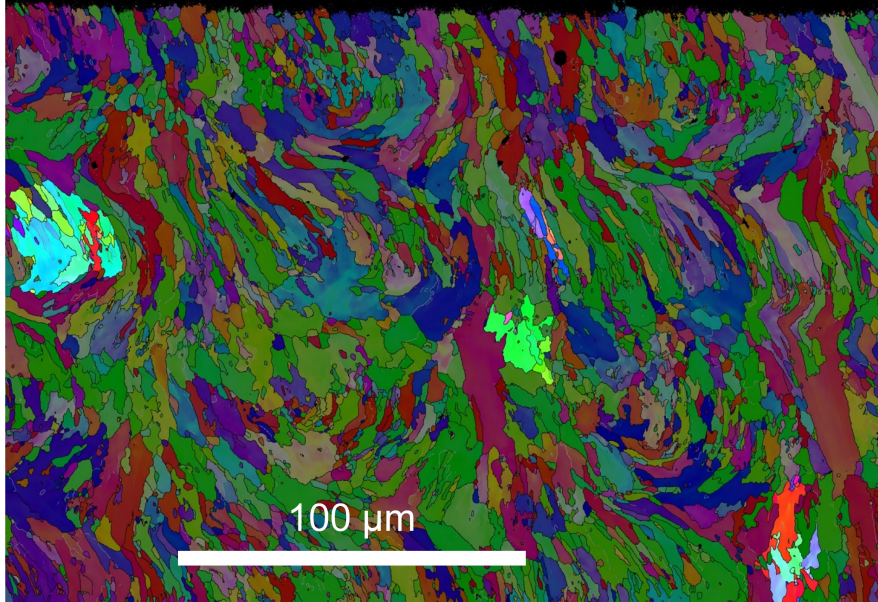


Figure S4. Highlighted TRDs showing five-fold symmetry axes, occupying 3.1% of the observed area.

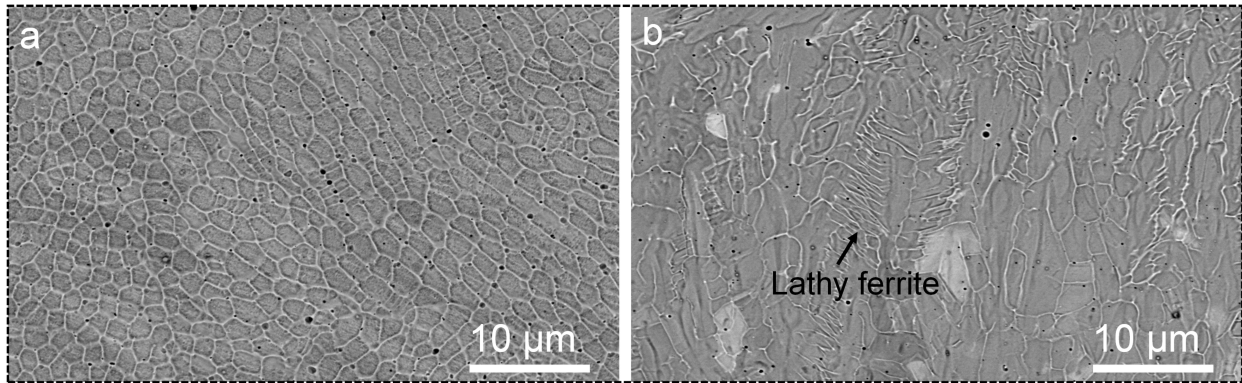


Figure S5. BSE images of etched microstructures of L-DED (a) 316L and (b) 316L-Si.