

S1. Information on EBSD

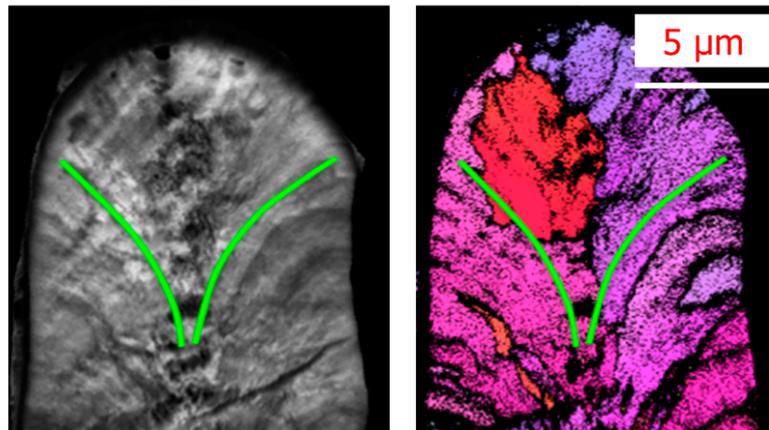


Figure S1. EBSD part of the picture in figure 1d: Image quality (IQ) map, and inverse pole figure (IPF) with CI=0.33 and cleaning dilation = 33, color coding as in figure 1d.

The spatial resolution of EBSD falls in the nanometer range but the nature of the phases, the combination of the microstructure / phase mean atomic number (Z) value/ high voltage / or the data treatment procedure such as “cleaning up” may decrease this resolution [28]. In the following part we recall several important quantities in EBSD analysis. For details, please refer to orientation imaging microscopy (OIM™) analysis manual.

Image quality map: Image quality (IQ) map constructed from EBSD data provides an effective approach to visualize microstructure [20]. It is a map with a grayscale component according to the relative intensity of the diffraction pattern, generally, with the maximum IQ value in white and the minimum one in black. The contrast in this image may due to the phase, stain, and grain boundaries.

Confidence Index: Confidence Index (CI) indicates the degree of confidence that the orientation calculation is correct, ranging from 0 (good) to 1 (perfect). It is a quantitative measure of the reliability of the indexed pattern. The low CI data is the one with very poor pattern quality, which may due to the amorphous phase, cracks, or grain boundary. The CI does not have to be 1 to consider the indexing is correct. The CI of the correct indexing solution is depending on the material properties [29].

Inverse Pole Figure: Inverse Pole Figure (IPF) displays the position of crystal orientation relative to a sample reference frame. In our case, the colour in IPF codes the crystallographic orientation aligned with the considered sample direction. Spatial distribution information of crystals can also be seen from IPF. In this image, the color in the black background represents the crystalline part that could be detected by EBSD.

“Clean up” process: “Clean up” process is a method in the software (OIM™ Data Analysis) to treat the points that did not give rise to diffraction or give a too weak diffraction pattern but having neighbouring diffracting points. If the misorientation among the neighbouring points is within the grain tolerance angle, they will belong to the same “grain” after clean up treatment. This means that, if a small amorphous region is located among large crystals that belong to the same “grain”, the amorphous region will be considered as crystallized with the orientation of the major “grain”, thus hiding the amorphous phase. Generally, one to two times “clean up” process is used in EBSD data analysis. In other words, there is a risk in using “clean up” process in EBSD data treatment exaggeratedly to introduce artifacts

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clean up settings) with the orientation of the major “grain”, thus hiding the amorphous phase. Generally, one or two times “clean up” process is used in EBSD data analysis and comparing the new data with the raw one. In other words, there could be a risk in using “clean up” process in EBSD data treatment exaggeratedly to introduce artifacts [28]. CI is generally mostly good when its value is sup./equal at 0.1

S2. The process of obtaining sample by FIB for TEM observations

Details of the process of FIB treatment are described in the appendix of Ref. [10]. Firstly, a sample is cut along a cross section of an irradiated line. Then, this plate is mirror polished. Subsequently, a micrometer thin layer of the laser-modified volume was picked up from the laser track using FIB under an angle of 45°. It is worth noticing that it contains the direction of writing. Following this, the above layer was dissected to reduce its thickness down to 100 nm using FIB at a very small angle. The sample after FIB treatment is thus a view in a plane that contains the direction of writing and either the laser propagation direction or is perpendicular to it.

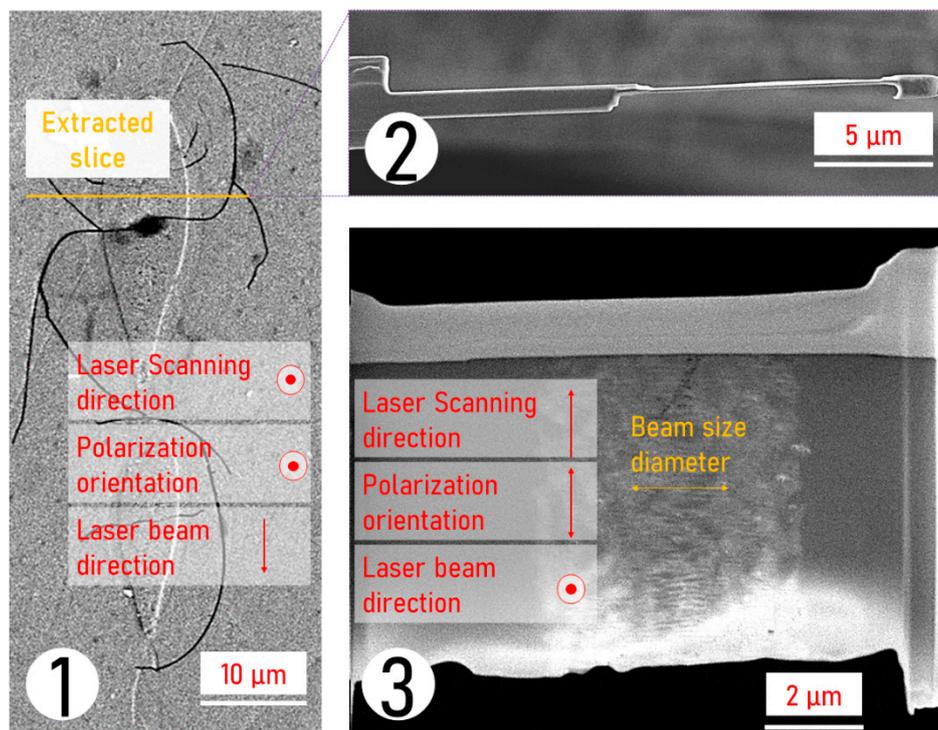


Figure S2. Description of the setup in three steps: 1- a slice is extracted by FIB; 2- the slice is subsequently placed on a TEM grid and thinned down to ~100 nm thickness; 3- the prepared slice is subsequently investigated by electron microscopy.