FIG. S1: The claybank-colored occluded twin grain is g398, which locates in the center of the semitransparent large grain g28 in specimen 316LL.
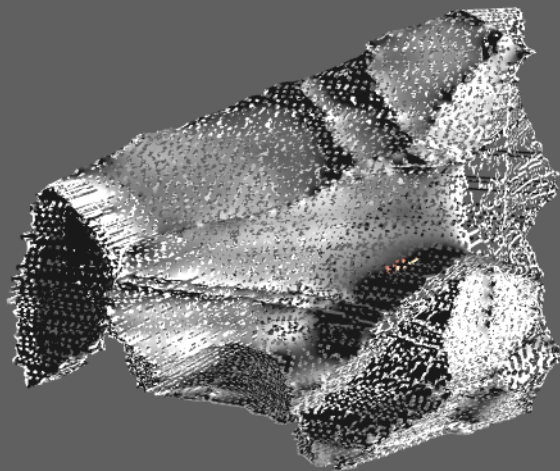
FIG. S2: Twin-boundary t717 between grain g344 and g778 in specimen 316LGBE

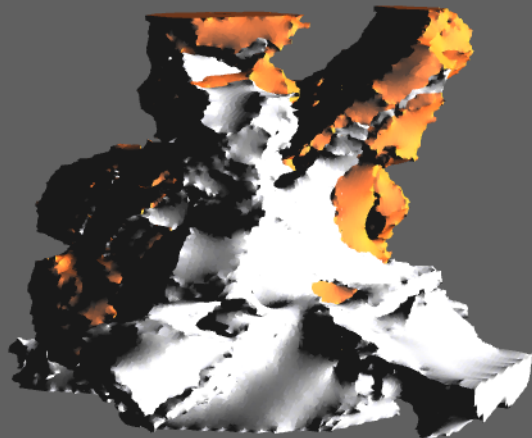FIG. S3: Assembly of grain g344 and g778 in specimen 316L-GBE
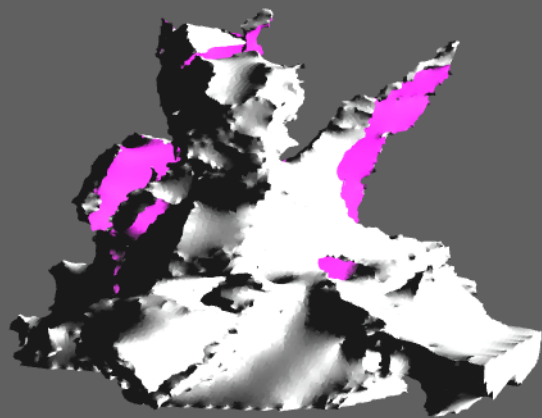
FIG. S4: Grain g344 in specimen 316LGBE

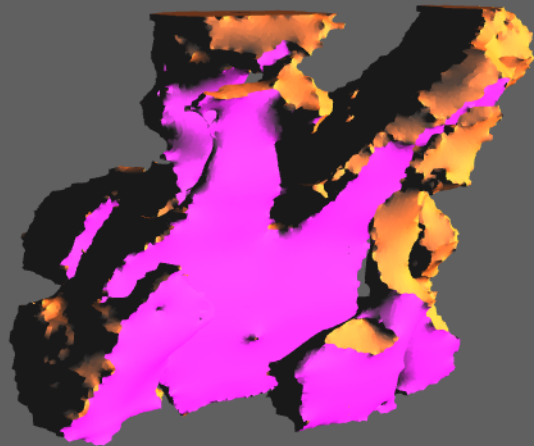FIG. S5: Grain g778 in specimen 316LGBE

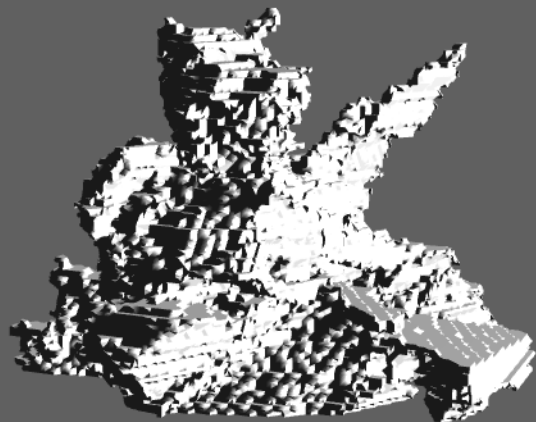FIG. S6: Grain g344 without surface smoothing in specimen 316LGBE

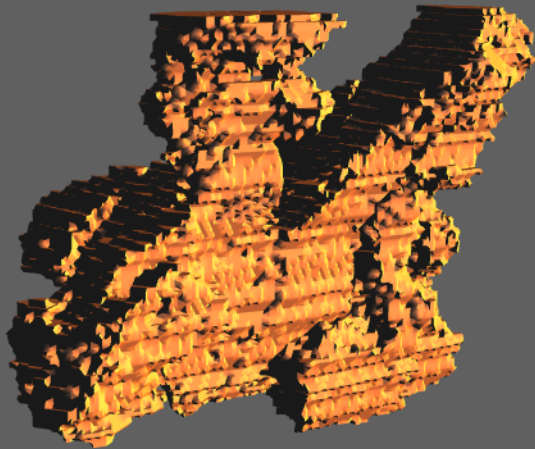FIG. S7: Grain g778 without surface smoothing in specimen 316LGBE

FIG. S8 Cumulative distributions in quantity (a, c) and in area (b, d) of twin boundary sizes (equivalent diameter of circle) of the 3D microstructure 316LS (a, b) and 316LGBE (c, d). $<d_{TB}>$ means the average diameter of twin boundaries, which are 30.0 μm and 38.3 μm for 316LS and 316LGBE, respectively.
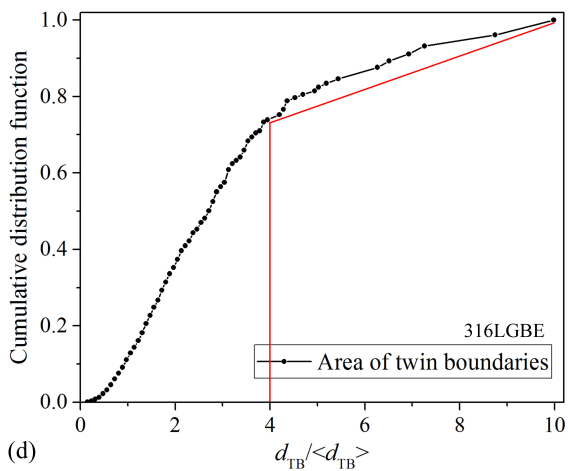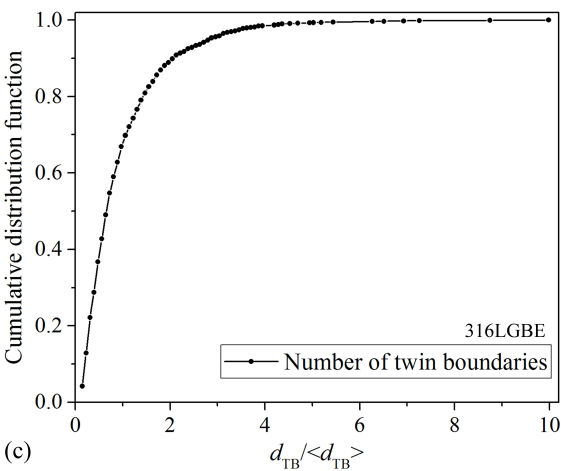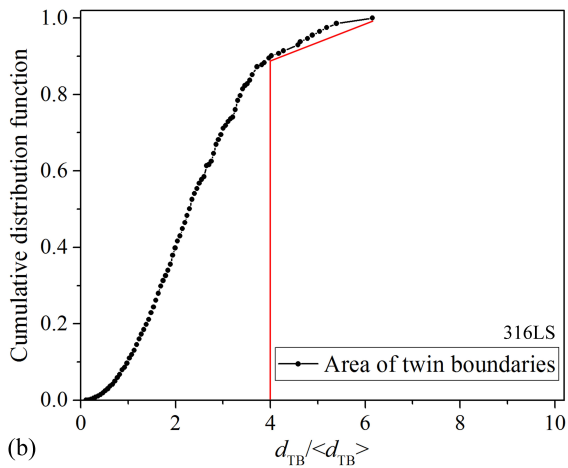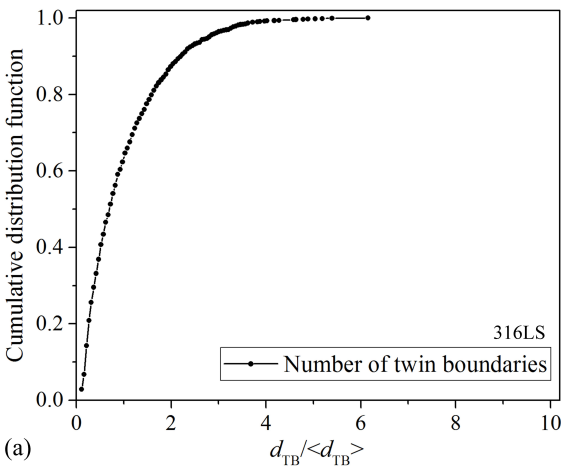
FIG. S9 GB networks with CSL characters in a 2D section of the GB engineered sample 316LGBE.