Crystallographic tools to study phase transformations by EBSD

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EBSD is mainly used to map the textures in deformed materials, but it also becomes an important technique to study phase transformations thanks to the recent progresses made in fast cameras, new SEM in-situ heating and deformation modules, 3D EBSD by FIB sectioning, and advanced computer treatments of the crystallographic data (subject of this talk).

Crystallography of phase transformations is based on group theory [1-2]. The crystallographic information of any structural transformation can be encoded in a groupoid composition table [2]. Cycle of phase transformations is still an open subject and algebraic/crystallographic theories have been developed "only" for multiple twinning in cubic materials [3, 4]. We have written a computer program ARPGE [5] that uses these theories to automatically treat the EBSD maps:
(a) The parent grains are automatically reconstructed without the help of possible retained parent phase. The sizes and textures of parent grains are automatically determined. Variant selection mechanisms can be studied by considering the distribution of operators between variants. Examples will be shown in iron, steels, titanium alloys and zirconia.
(b) The twin related domains (TRDs) in low staking fault cubic materials are automatically identified. The fractal representation of the TRDs, their sizes, the twinning orders and the distribution of the $\sum 3^n$ operators are automatically calculated. Examples will be given in copper, nickel alloys, silicon and CdTe.

During this talk we will also show how EBSD pole figures in martensitic steels were used to establish a new model of the fcc-bcc martensitic transformation [6].

References

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