Using Machine Learning and Topographic SEM Imaging for Software Assisted Fractography

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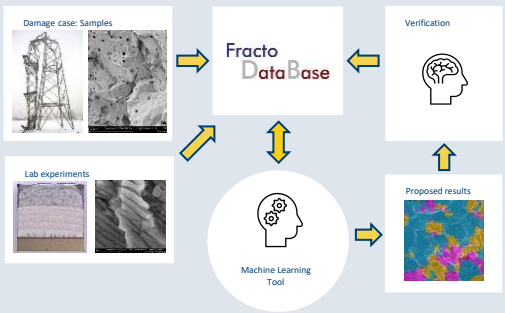
Objectives

Advantages of software assisted fractography

- Supports complex fractographic analysis
- Provide und applies expert knowledge
- Enables quantitative results for better comparability
- Standardizes comprehensive graphical annotation and reports [1]

Using artificial intelligence

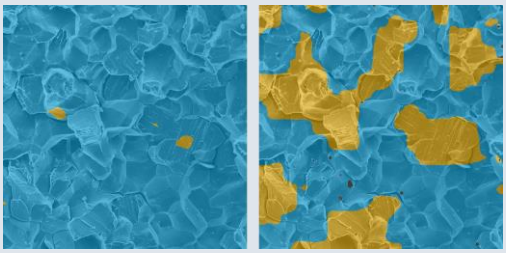
- Application of machine learning tool
- Large number of classified data required for training network
- Initial expert knowledge for verification



Principle of software assisted fractography: Application of machine learning tool and knowledge base. Verified results improve the data base.

Results

- Application and comparative tests with SEM data of several metallographic fracture samples [3]
- Evaluation of fracture surface characteristics
- Determination of the fracture mechanism
- Consideration of different scales (SEM magnification) and imaging parameter



Classification results as coloured overlay with SE image (blue: grain boundaries, yellow: cleavage areas). Left: Predicted surface characteristics from SE images only, right: improved results with additional topographic data

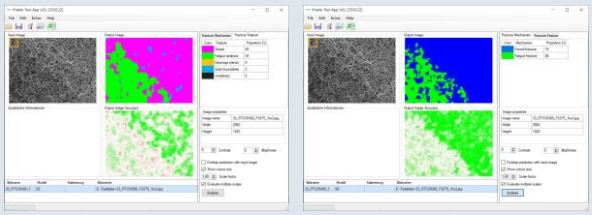
Summary

- Test application ready for quantitative fractography
- Classifier and training data enhanced with topographic data
- Better results with multi-sensor SEM data

Applied Techniques

Machine learning based software

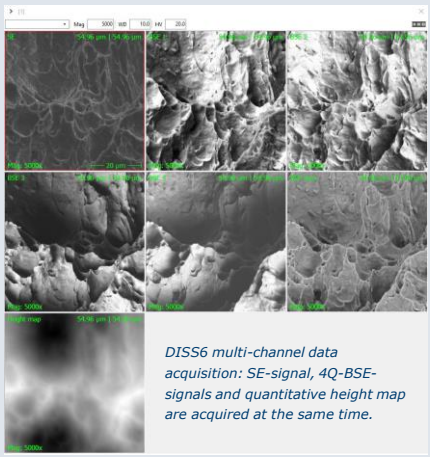
- Classification of fracture characteristics and mechanisms
- Single image or multi-channel signals as input data (SE, BSE, Height maps)
- Visualization of results with map overlays and graphical editor



iFracto test app: Classification of fracture characteristics (left) and fracture mechanisms (right). Upper left view in app: Input data, upper right: results, lower right: Accuracy

Multi-Sensor SEM imaging

- Multi-channel SEM data acquisition (SE, BSE, Height map …)
- Integrated topographic mapping [2]
- Data interface between SEM/Topo imaging and AI software



DISS6 multi-channel data acquisition: SE-signal, 4Q-BSE-signals and quantitative height map are acquired at the same time.

Acknowledgements / References

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