Characterization of morphology and microstructure of different kinds of materials at NTNU Mater Sci EM Lab

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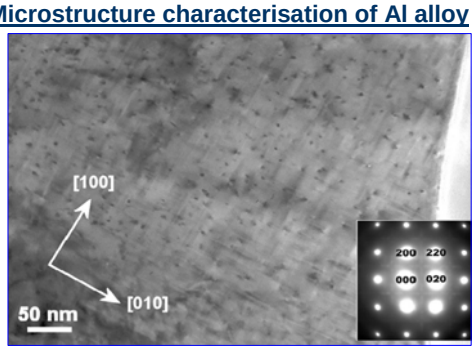
Introduction

The NTNU Materials Science and Engineering EM Lab is equipped with electron microscopy facilities carrying out NTNU multi-disciplinary materials science research. The laboratory is executing research activities for various material departments at the university. Here we present several recent characterization examples from different kinds of materials by use of electron probe micro analyser (EPMA), scanning electron microscopy (SEM) and transmission electron microscopy (TEM).

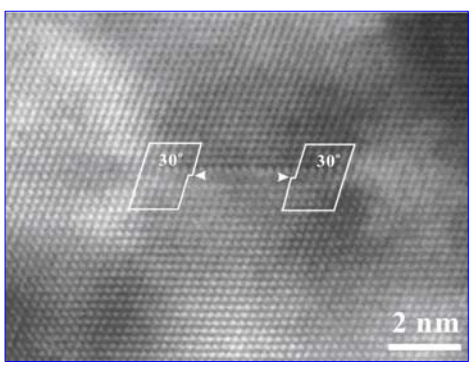
EM technique

- EPMA can provide precise quantitative element measurements and X-ray mapping (JXA-8500F EPMA).
- SEM can provide both chemical composition and surface morphology information at high spatial resolution. (Zeiss Ultra 55 FEG SEM and Zeiss Supra 55VP FEG SEM).
- TEM can provide both chemical composition and crystal structure at high spatial resolution (JEM 2010 TEM).

Microstructure characterisation of Al alloy

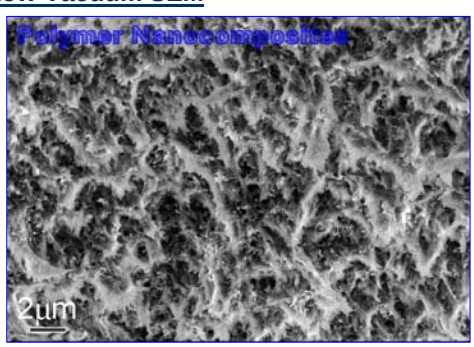


Digital transmission electron microscopy (TEM) micrograph of an Al-Mg-Si alloy. Further semi-automatic particle analysis by using imaging software could give the detailed information of the hardening phase distribution in this commercial Al alloy, this distribution being an important parameter for understanding the microstructure–mechanical property relationship.



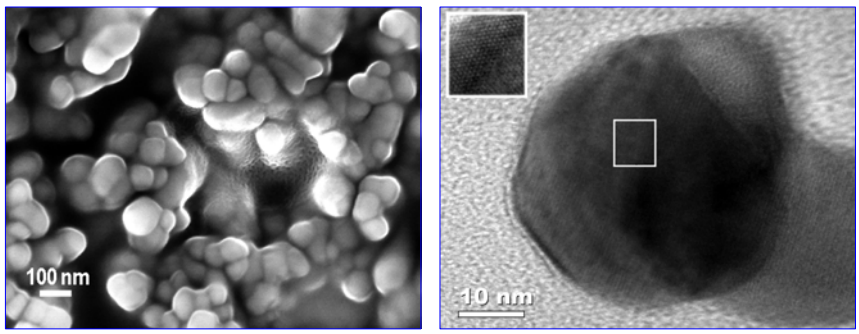
The development of bulk nanostructured material (BNM) from this commercial alloy produced by severe plastic deformation (SPD) [1] has been revealed at atomic level by high resolution TEM.

Low Vacuum SEM



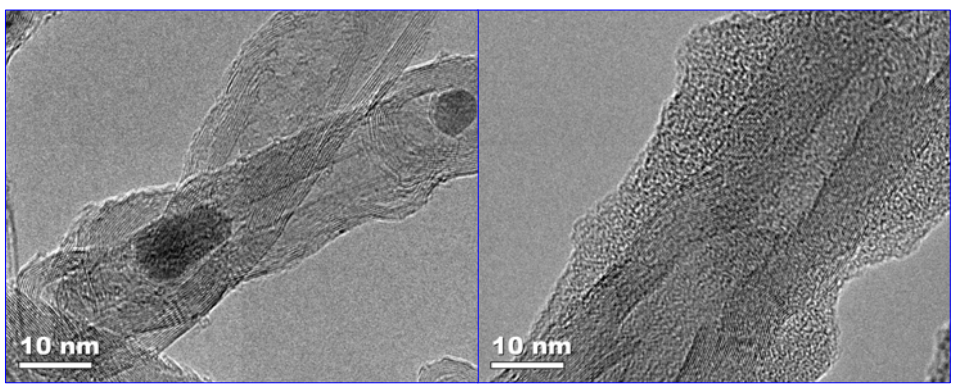
A variable pressure (VP) SEM micrograph of a nano-composite polymer. Without using conducting coating, the nano-enhanced particles in this polymer system could be identified clearly in the VP SEM mode [3].

SEM and TEM Catalyst particle characterization



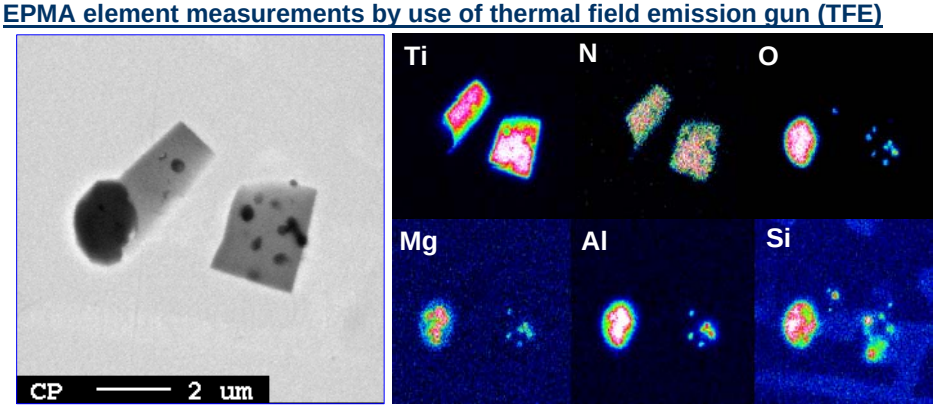
Catalyst particle characterization is the basis for catalyst production and the performance of such particles. Left figure shows a secondary electron equivalent image from Zeiss in-lens detector (Zeiss Supra 55VP). The high-resolution TEM image on the right confirmed the full crystallization of the individual particles, completing the full range of microstructure characterization of this catalysis system [2].

MWNT polymerization characterization



The high-resolution TEM images of multi-walled carbon nanotubes (MWNT, left) and after polymerization (right).

EPMA element measurements by use of thermal field emission gun (TFE)



Sub-micron resolution X-ray mapping from a pig iron sample where small oxide inclusions could be identified inside large titanium-nitride lamellar particles. The resolution of the X-ray image is about 200 nm.

Acknowledgements

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References

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2. T.J. Zhao, D. Chen et al., Norwegian Patent Application (2008).(2001).
3. L. Shao., Ph.D. Thesis, NTNU2008:189, Norwegian University of Science and Technology, Trondheim (2008).

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