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

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Lab of Electron Microscopy (Mater. Sci. EM Lab) is responsible for the electron microscopy facilities to assist NTNU multi-disciplinary materials science research. Through many year efforts with our academic competence, the EM lab is well ready for serving the research activities from various materials departments in the university. Here we present several recent characterization examples from different kinds of materials.

Figure 1(a) shows a digital transmission electron microscopy (TEM) micrograph of Al-Mg-Si alloy from our JEM-2010 TEM which is equipped with a sensitive CCD camera. 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 as an important parameter for understanding the microstructure–mechanical property relationship in the traditional light metal industry in Norway. Meanwhile, the microstructure development of bulk nanostructured materials (BNMs) from this commercial alloy produced by severe plastic deformation (SPD) [1] has been revealed at atomic level by high resolution TEM as shown in Fig. 1(b). Catalyst particle characterization is the basis for catalyst production and future performance. Figure 2(a) shows a scanning electron microscopy (SEM) micrograph from our Zeiss in-lens detector (Zeiss Supra 55VP), in which a careful sample preparation was employed to disperse particles exactly on the same imaging plane for archiving nanosacle resolution at a shorter working distance (WD). Further high-resolution TEM image of Fig. 2(b) confirmed the full crystallization of individual particles, which gives a whole range microstructure characterization of this catalysis system [2]. Figure 3 shows a variable pressure (VP) SEM micrograph of a nano-composite polymer, in which the SEM gas pressure was carefully controlled to form the thinnest conducting ionizing layer for getting the best VP SEM resolution. Without using conducting coating, the nano-enhanced particles in this polymer system are definitely identified in the VP SEM mode [3]. Furthermore, precise and quantitative element measurements and x-ray mapping can be performed by our electron microprobe (JXA-8500F), and Figure 4 shows a submicron resolution X-ray mapping from the pig iron sample where the small oxide inclusions could be identified to exist inside the big titanium-nitride lamellar particles. The EM Lab is also involved in intensive research programmes for electron back scatting diffraction (EBSD), and some results are also presented at the conference.

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1. M. Liu, H.J. Roven and Y.D. Yu, Zeitschrift für Metallkunde **3** (2007), p. 184.
2. T.J. Zhao, D. Chen et al., Norwegian Patent Application (2008).
3. L. Shao, PhD Thesis, Norwegian University of Science and Technology (2008).

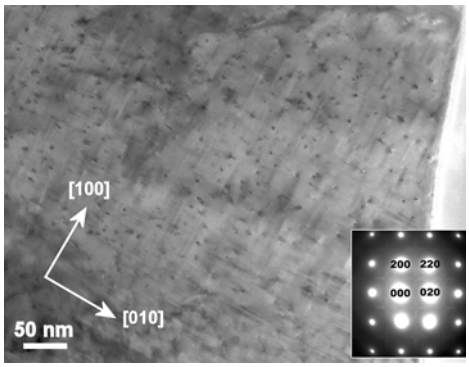

Figure 1a. High-resolution TEM image of the hardening phase distribution in a commercial aluminium Al-Mg-Si alloy.

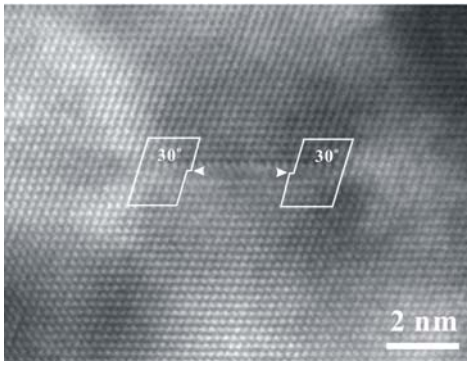

Figure 1b. A screw dislocation dissociated into two Shockley partials connected by an intrinsic stacking fault in SPD Al.

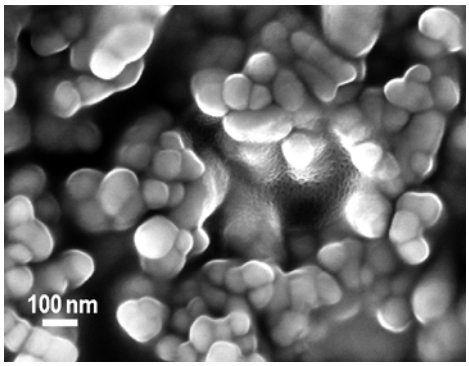

Figure 2a. SEM micrograph of the catalyst particle distribution at WD of 4 mm.

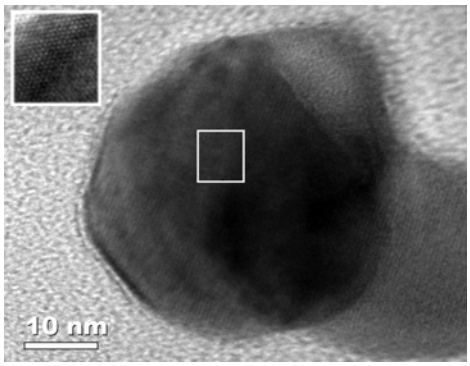

Figure 2b. High-resolution TEM image of one of the catalyst particles in Fig. 2(a).

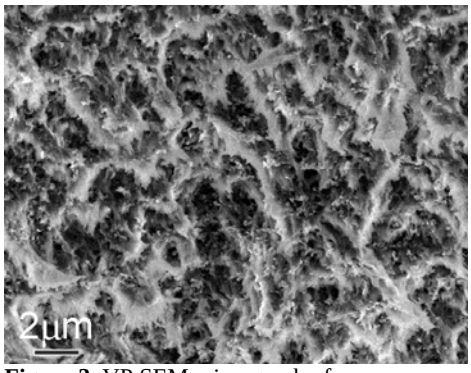

Figure 3. VP SEM micrograph of a nano composite polymer at the 8 Pa gas pressure.

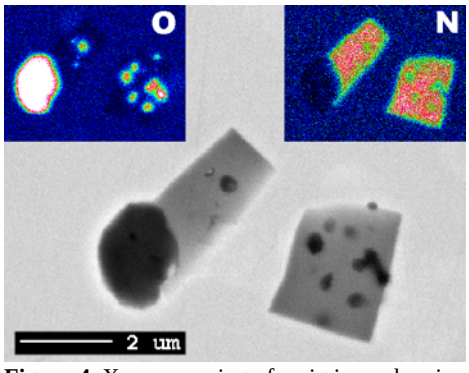

Figure 4. X-ray mapping of a pig iron, showing the inclusions as oxides and lamellar nitrides.