The Canadian Centre for Electron Microscopy provides world-class electron microscopy capabilities and expertise. We are the go-to provider of electron microscopy services to Canadian industry and researchers working in a broad range of fields. Located at McMaster University and operated by the Brockhouse Institute for Materials Research, the CCEM features state-of-the-art instrumentation and experienced, dedicated staff who are happy to work with you to find solutions to your materials research and development questions.

Automotive

The pursuit of fuel efficiency drives a continuous search for new light-weight, high-performance materials for automotive applications. The CCEM pursues detailed investigations of candidate materials and provides chemical and microstructural data to aid in process development. We have experience investigating many automotive materials, including microstructures of novel steel compositions, atomic-level details of cracks and defects, and the structure and composition of paints and pigments.

We can provide

- grain and phase identification, size/volume analysis
- dislocation imaging and deformation mechanism determination
- crack measurement and analysis
- identification and analysis of oxides, corrosion products
- crystallographic and orientation data

> “[Electron energy loss spectroscopy] is suitable for studying the steel-coating interface at the fine length scales available to the transmission electron microscope, where fine oxides can remain after metallic coating.”
>
> **A.P. Grosvenor et al**
> Applied Surface Science 379 (2016) 242–248

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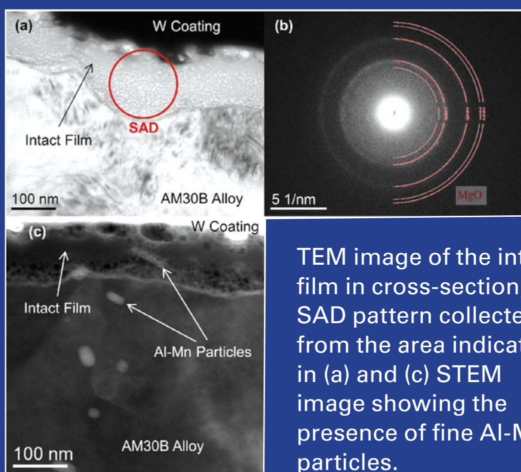
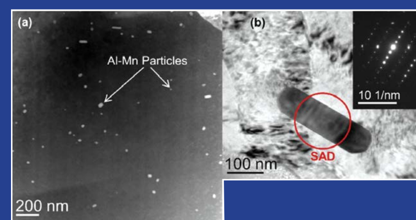
Cathodic activity of corrosion filaments formed on magnesium

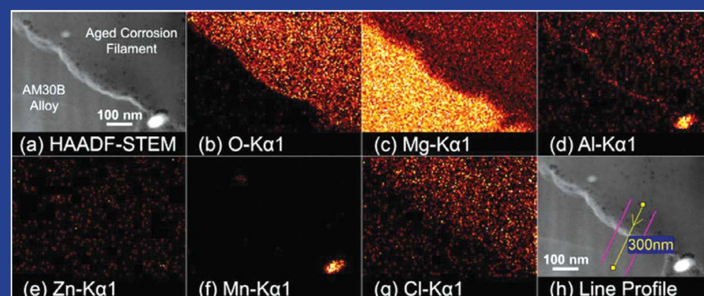
During corrosion in certain environments Mg alloys can exhibit spreading corrosion products, resembling filaments or expanding discs. A preliminary study explored links between cathodic activity and these filament structures; follow-up work was done to develop a deeper understanding of the driving forces. A TEM investigation, accompanied by electrochemical investigation techniques, revealed that the cathodic activity probably resulted from MgO film formation in combination with intermetallic particles catalyzing a cathodic gas evolution reaction. An Al-rich layer at the interface between the film and the alloy was also observed to form but did not prevent the formation or growth of the corrosion filaments.



TEM image of the intact film in cross-section, (b) SAD pattern collected from the area indicated in (a) and (c) STEM image showing the presence of fine Al-Mn particles.



STEM images of particles found in the bulk microstructure, (b) SAD pattern obtained from a relatively large Al-Mn intermetallic particle.

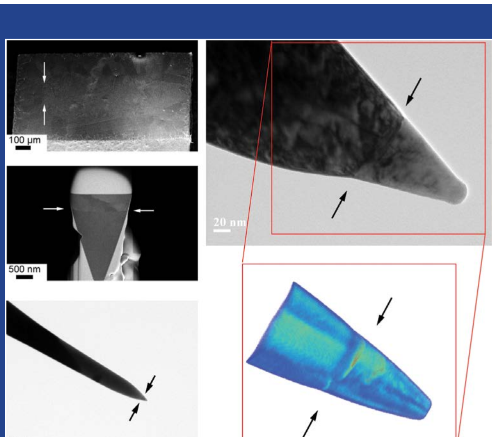


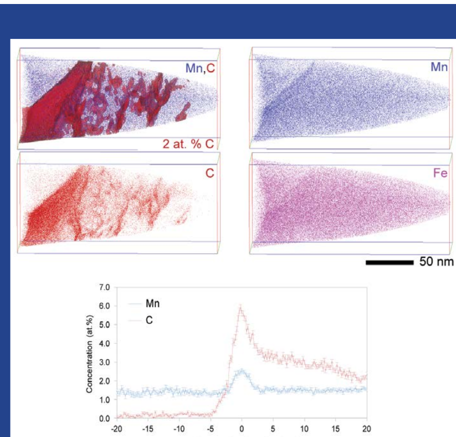
STEM image of aged corrosion filament and (b)-(g) corresponding EDS maps for O, Mg, Al, Zn, Mn and Cl across the filament/alloy interface.

REFERENCE Cathodic Activity of Corrosion Filaments Formed on Mg Alloy AM30, Z. P. Cano, J. R. McDermid, J. R. Kish, J. Electrochem. Soc. 162 (2015) C732-C740

Investigation of solute segregation to austenite-ferrite transformation boundary during decarburizing

Solute segregation during the transformation from austenite to ferrite in advanced high-strength steels used for structural automotive components can have a significant impact on the microstructure after decarburizing or denitriding. To obtain the ideal fraction of ferrite the process parameters must be controlled for each steel composition. Atom probe tomography can measure the segregation of solute elements very precisely in specimens extracted at various stages in the process; the data is used to build accurate transformation models to predict the required process parameters.





Analysis by atom probe tomography reveals the austenite-ferrite interface, and the distribution of alloying elements in the material. Segregation can be visualized in 3D, and mapped over planar or complex interfaces to produce composition profiles.

REFERENCE Solute Segregation During Ferrite Growth: Solute/Interphase and Substitutional/Interstitial Interactions, H.P. Van Landeghem, B. Langelier, D. Panahi, G.R. Purdy, C.R. Hutchinson, G.A. Botton, H.S. Zurob, JOM 68 (2016) 1329–1334