

Growth defects in copper cathodes

S. MIDDLEMISS¹, C.L. CIOBANU¹, A. SLATTERY¹,
K.J. EHRIG^{2*}, N.J. COOK¹

¹ The University of Adelaide, SA 5005, Australia

(shay.middlemiss@student.adelaide.edu.au; cristiana.ciobanu@adelaide.edu.au; ashley.slattery@adelaide.edu.au; nigel.cook@adelaide.edu.au)

² BHP Olympic Dam, Adelaide, SA 5000, Australia

(correspondence*: Kathy.J.Ehrig@bhpbilliton.com)

Nanoscale characterisation of impurities and lattice-scale defects in copper cathodes from the Olympic Dam refinery, South Australia, assists understanding how growth defects develop during the electrowinning process. Areas representing different aspects of growth were analysed using FIB-prepared TEM foils. Results show transitional fan-like growth, from coarse- to fine-grained copper surrounding inclusions of impurity PbS. Polysynthetic twins and ‘basket-weave’ textures (Fig. 1a, b) are present throughout all layer types but sets of curved, rolling twins are unique to the good growth layers. HAADF STEM imaging of the ‘basket-weave’ textures show displacement along (111) twin directions (Fig. 1c) and super-structuring down to [1-10] zone axis (Fig. 1d). Analogous features are attributable to periodic interface modulated structures in mixed layer compounds [1].

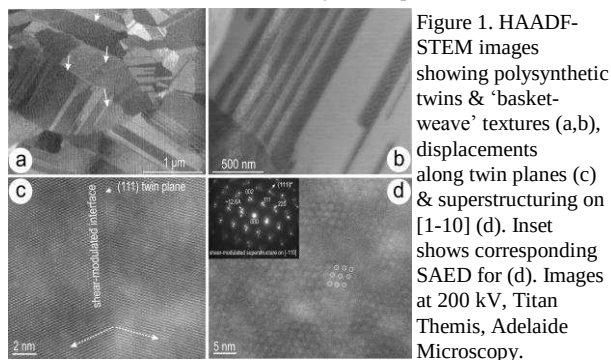


Figure 1. HAADF-STEM images showing polysynthetic twins & ‘basket-weave’ textures (a,b), displacements along twin planes (c) & superstructuring on [1-10] (d). Inset shows corresponding SAED for (d). Images at 200 kV, Titan Themis, Adelaide Microscopy.

Fast growth is the main factor maintaining steady copper deposition in a single direction and thus counteracting interactions with slimes responsible for impurities. ‘Basket-weave’ textures, associated with crystal-structural modularity in the copper, are indicative of fast growth. These textures are irregularly expressed throughout cathode layers with defect growth but are well-sustained in good layers. Impurities, as inclusions, are likely formed at all stages during slow growth but tend to be dissolved and re-precipitated during subsequent growth cycles. The presence of impurities is thus interpreted as a result rather than a cause of defect growth.

[1] Van Tendeloo et al. (1987), Phys Stat Sol A101, 339-354.