CHARACTERIZING ENVIRONMENTALLY ASSISTED CRACK INITIATION AND SHORT CRACK GROWTH

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There are an increasingly wide array of techniques and approaches that can be used to help understand environmentally assisted cracking (EAC). I will give an overview of recent work at The University of Manchester where we have focused on understanding the very early stages of crack initiation and short crack growth in aluminum and stainless steel. I will show how initiation and short crack growth are distinct mechanistic stages of EAC and demand dedicated investigation and interpretation. In many cases it is these early stages that can dictate the ultimate lifetime of materials in service either through the time taken for initiation or how the initiation influences the conditions for propagation that follow. The difficulty of observing small transient events over long timescales is difficult both temporally and spatially and needs a novel approach. Figure 1 highlights an example of post mortem characterization following in situ testing where the initiation site in AA7085-T7651 subjected to 4 point bending in warm humid air has been unambiguously identified. I share recent results where we have observed in situ initiation events in both high strength aluminum and stainless steel samples and coupled this with an exceptionally detailed characterization before and after cracking to understand the interaction with the materials microstructure.

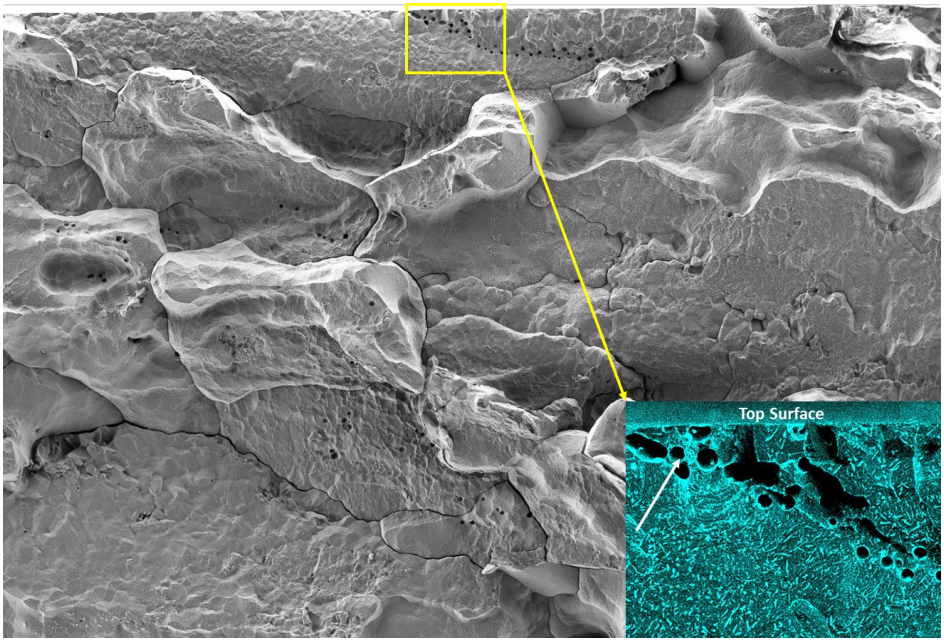

Figure 1 – Secondary electron micrograph with inset EDX spectrum map showing Oxygen distribution of an intergranular environmentally assisted crack fracture surface of commercially sourced AA7085-T7651 aluminum exposed to 50% RH, 70 °C and 85% of the yield strength. Yellow box highlights the pore cluster where the cracking initiated and the white arrow shows the increased oxygen signal as the suspected point of initiation.