RECOMMENDATIONS AND RANTS REGARDING RESEARCH ON ENVIRONMENTALLY ASSISTED CRACKING

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Controversies concerning mechanisms and kinetics of environmentally assisted cracking seem to be increasing despite (or because of?) the accumulating numbers of papers and the increasing capabilities of techniques used to study the phenomena. My presentation will discuss the approaches and experiments that I would like to see undertaken (given that I have 'retired' and do not have the resources or students to carry them out) to address this unsatisfactory state of affairs. I will also address some of the misunderstandings and misconceptions regarding mechanisms of environmentally assisted cracking that have appeared in the recent literature. A primary recommendation (and plea) is for more studies of liquid-metal embrittlement (LME) (in systems involving only adsorption at crack tips) since this type of LME is the least complex case of environmentally assisted cracking, and there are still many aspects that are not well understood (as will be outlined). More studies of LME would provide a better basis for understanding the more complex phenomena of hydrogen embrittlement (HE) and stress-corrosion cracking (SCC), as previous studies have demonstrated to some extent. Using single crystals and bi-crystals as well as studying complex commercial alloys would obviously be a logical approach. One of the common misconceptions regarding environmentally assisted cracking (in my opinion) is that hydrogen-assisted cracking (when hydrides are not involved) occurs primarily by hydrogen enhanced localised plasticity (HELP) involving solute hydrogen facilitating dislocation activity in the plastic zone ahead of cracks, and I will discuss why I think that this view is misconceived. The adsorption-induced dislocation emission (AIDE) mechanism for some HE and LME systems is supported by numerous observations, but is often misunderstood (judging by the discussions in a recent conference proceeding [1]), and clarifications will be provided.

[1] The challenges of hydrogen in metals, Philos. Trans. Roy. Soc. A, Vol. 375, July,2017, T. Paxton, A.P. Sutton, and M.W. Finnis (Eds).