

## The link between microstructural heterogeneity and hydrogen redistribution

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### Abstract

Green hydrogen is likely to play a major role in decarbonising the aviation industry. It is crucial to understand the effects of microstructure on hydrogen redistribution, which may be implicated in the embrittlement of candidate fuel system metals. We have developed a multiscale finite element modelling framework that integrates micromechanical and hydrogen transport models, such that the dominant microstructural effects can be efficiently accounted for at millimetre length scales. Our results show that microstructure has a significant effect on hydrogen localisation in elastically anisotropic materials, which exhibit an interesting interplay between microstructure and millimetre-scale hydrogen redistribution at various loading rates. Considering 316L stainless steel and nickel, a direct comparison of model predictions against experimental hydrogen embrittlement data reveals that the reported sensitivity to loading rate may be strongly linked with rate-dependent grain scale diffusion. These findings highlight the need to incorporate microstructural characteristics in hydrogen embrittlement models.