HYDROGEN TRAPPING MECHANISMS OF INTERPHASE PRECIPITATION TiC and (Ti,Mo)CIN FERRITIC STEELS

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The presence of hydrogen in steels can reduce material toughness, leading to unpredictable failure that is known as 'hydrogen embrittlement (HE). The introduction of hydrogen traps into alloy microstructure to restrict hydrogen diffusion towards HE-susceptible areas such as microcracks is a potential solution against HE. Nanosized transition-metal such as Ti and Mo carbides can serve as hydrogen traps with high number density and good dispersion in steels. However, their hydrogen trapping mechanism has not yet been clear, particularly whether trapping is enabled by carbide bulk or carbide-ferrite interface.

To answer this, we used atom probe tomography with a cryogenic sample transfer protocol to examine hydrogen trapping in two model ferritic steels that contain TiC and (Ti,Mo)C, respectively. With the addition of substitutional Mo, the (Ti,Mo)C sample was designed to have carbon vacancies that can serve as hydrogen traps and diffusion paths to facilitate hydrogen penetration in carbide bulk. In contrast, stoichiometric TiC with less carbon vacancies should present interfacial hydrogen trapping that contrast to (Ti,Mo)C. A preliminary TiC data is shown in Figure 1.

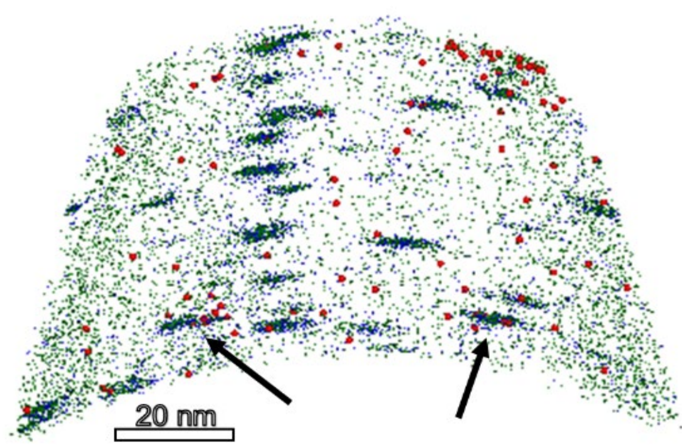

Figure 1 The cryo-APT observation of the titanium carbide in steel with deuterium charging. (red: deuterium, green: titanium, grey: carbon, blue: iron)