Contribution ID: **93** Type: **Talk**

# Time evolution of hydrogen diffusion in Zirconium alloys at 300℃-400℃ by in-situ neutron imaging experiments

*Tuesday, December 7, 2021 5:05 PM (25 minutes)*

Zr based alloys are widely used in nuclear power plants as nuclear fuel cladding. These materials have an excellent combination of mechanical resistance, corrosion resistance and very low neutron absorption. However, they are susceptible to H degradation, following incorporation of H by a slow oxidation process at operating temperatures (~300℃). For long operational service, Zr based components can fail by a crack growth mechanism associated with the hydrides known as Delayed Hydride Cracking (DHC). H redistributes by solid diffusion and accumulates at stress raisers or cold spots, where it precipitates as a brittle hydride once the solubility is exceeded. Hence, a correct determination of the H diffusion coefficient and the phenomena involved in the dissolution and precipitation of hydrides in Zr alloys are important issues for the safe operation of nuclear power plants. Since the attenuation coefficient for cold neutrons of H is higher than for Zr alloys, neutron imaging represents an excellent technique to study the H concentration and diffusion in Zr alloys. In this work, the time evolution of H diffusion in Zr alloys at temperatures between 300℃ and 400℃ was determined by neutron imaging at the ANTARES cold neutron imaging facility. In-situ annealing was performed, obtaining a spatial resolution of ~30 μm per pixel while the time step analyzed was 15 min. A moving boundary between the regions of the precipitated hydride and the solid solution was observed.

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**Session Classification:** Material Science

**Track Classification:** Material Science