Digital Transformation Approach to Hydrogen Embrittlement

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The development of technologies for the safe production, storage, transportation, and utilization of hydrogen is crucial for the realization of a Hydrogen Society, where hydrogen is widely used in daily life, transportation, and industrial activities. Unlike other gases, hydrogen can cause the degradation of metallic materials through a process known as hydrogen embrittlement, which includes hydrogen-induced cracking and hydrogen-assisted fracture. The effects of hydrogen atoms on materials have been a subject of significant interest and research in the fields of materials science and engineering for the past 150 years. Due to the potential for catastrophic failures in critical structures and components, understanding and mitigating this insidious and often unpredictable process has become a crucial research area, particularly in the high-pressure hydrogen gas equipment sector, attracting numerous studies worldwide.

In recent years, there has been an increasing trend of utilizing digital transformation approaches to expedite research in various engineering fields. This is also true for the evaluation of materials strength. In this context, the presenter is involved in the Research Initiative of Structural Materials for Extreme Environments (RISME) at Tohoku University. The presenter's work focuses on developing a novel evaluation method for the hydrogen-embrittlement properties of steels, leveraging applied statistics and image analysis (Fig. 1). This research collaboration involves multiple disciplines, including data science, numerical simulation, material development, and strength evaluation.

During the presentation, the background of the research activity will be introduced, followed by the presentation of interesting findings and outcomes.

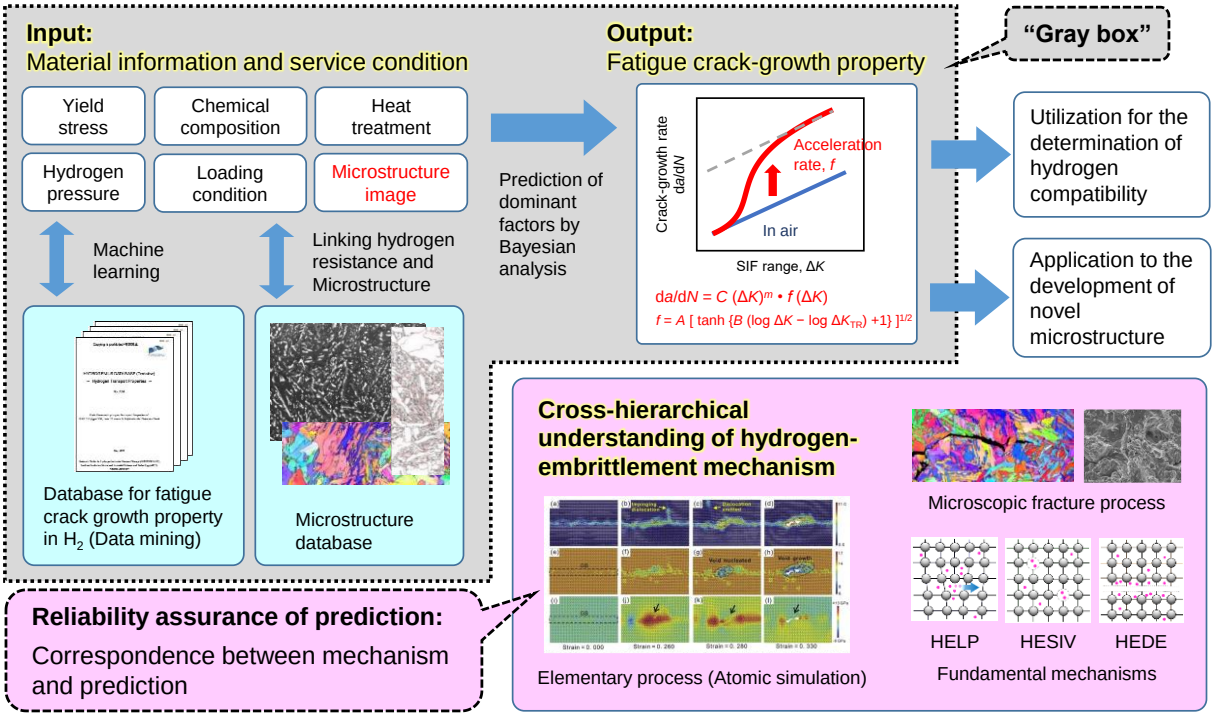

Fig. 1 Prediction system for fatigue crack growth properties in hydrogen gas.

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