FAILURE PREDICTION AND PREVENTION BY KNOWLEDGE MANAGEMENT IN SOLID OXIDE FUEL CELL DESIGN

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INTRODUCTION

In order to introduce solid oxide fuel cell (SOFC) systems into the existing energy market successfully, the SOFC systems must operate with as little failure as possible. Therefore, the systems must be designed to be highly reliable. In order to design highly reliable fuel cell systems, research studies on the prediction and prevention of failures specific to SOFC systems are necessary, and the results of those studies must be included the design process of SOFC systems. A system that enables designers to predictively analyze the causal chain of failure mechanisms and prevent potential failures in the system is proposed.

METHOD TO ACQUIRE AND REUSE FAILURE KNOWLEDGE FOR FAILURE PREDICTION

Systematization of the knowledge on known failures is necessary for the realization of the failure prediction and prevention system. However, because fuel cell technology is still in its infancy, there is not enough knowledge based on actual experiences of actual fuel cell systems. Therefore, we also need to make use of the knowledge accumulated from experiences of failures in designs of products and systems that are currently on the market in order to make possible a thorough prediction of potential failures in fuel cell systems. This knowledge exists in a fragmented state. Therefore, in order to reuse this failure knowledge from other fields, we abstract the essence of that knowledge on failure mechanisms according to the following three concepts; the segmentation of the causal chain, generalization, and contextualization. To achieve these knowledge management principles, we use the Stress-Strength Model (SSM) system (1-2). The SSM system has already been applied to the acquisition of knowledge on failures in the field of mechanical products design, and the concept of a causal chain structure based on SSM (hereafter, SSM based knowledge structure) has been realized as a knowledge structure within the SSM system. The details of the SSM system are presented in the paper.

METHOD FOR FAILURE PREDICTION IN SOLID OXIDE FUEL CELL DESIGN

Thinkingought Process of Predictive Analysis of Failures

We propose the following thought process for predicting causal chains of failures in designed SOFC systems.

Step1. Identify the relationships between the designed components of the fuel cell to be evaluated

Step2. Abstract the attributes of the SOFC to be evaluated based on the design as well as the conditions that will be imposed on the SOFC throughout its life cycle in order to determine the defining attributes and controlling attributes of each component of the SOFC together with the stresses that are exerted on that component.

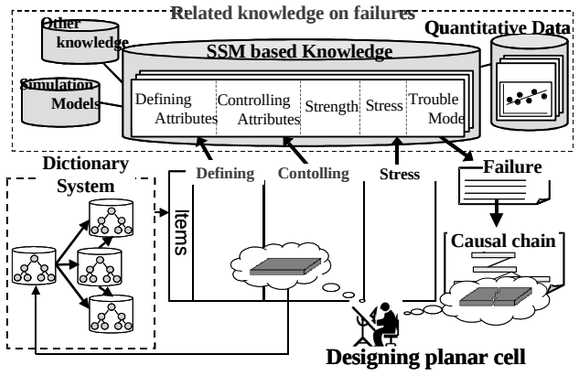

Fig.1 Thought process of failure predication

Step3. Find the possible failures that could occur as a result of the defining attributes, controlling attributes, and stresses exerted on all of the components that need to be investigated through predictive analysis based on the modularized knowledge of failure mechanisms.

Step4. Construct causal chains of failures among the investigated components based on the knowledge of failures available from expert designers and engineers.

The thought process above is shown in Fig. 1. We have developed a prototype system that realizes the thought process described above. In the prototype system, 29 modules of knowledge on failures in SOFC system were abstracted from the experiences and knowledge in the literature. In the presentation, we will explain how the system can be used to predict causal chains of failures that would occur in the cathode of an SOFC that is being designed.

ACKNOWLEDGEMENTS

This research was supported by funding from the Alliance for Global Sustainability and the Industrial Technology Research Grant Program from New Energy and Industrial Technology Development Organization (NEDO) of Japan, Project ID: 01B62010d

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