New visualization method by two-dimensional imaging of transmitted hydrogen on stainless steel

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The behavior of hydrogen in metals should be made clear to understand the mechanisms of hydrogen embrittlement and storage. To understand these phenomena, various hydrogen diffusion models have been proposed. We have observed the behavior of hydrogen in metals by visualizing sequentially spatial distributions of permeated hydrogen on the surface of stainless steel membrane. The distributions of surface hydrogen were obtained using ions emitted by the method of desorption induced by electronic transitions (DIET) process with the scanning electron microscope (SEM)[1]. The experimental setup is shown in Fig. 1. The two-dimensional pulse counting system is synchronized with the scanning electron beam. The sample is SUS304 stainless steel, which has austenite structure with martensite dislocations caused by cold working. The diameters of austenite grains are about 100 μm. The thickness of membrane is 200 μm. The back side of SUS membrane was exposed to hydrogen (2.5×10^5 Pa) and the permeated hydrogen on the opposite observation side was observed by DIET method.

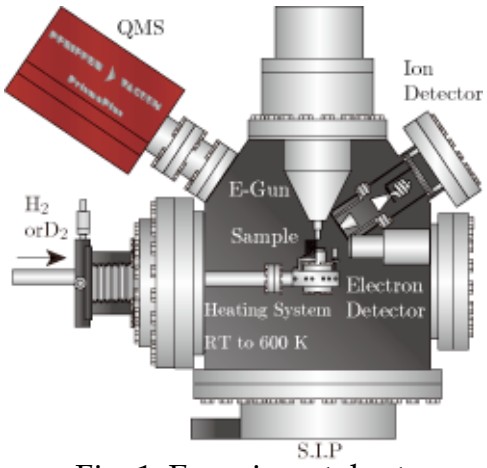

Fig. 1: Experimental set up

Fig. 2(a) and (b) are the secondary electron image and the permeated hydrogen map which is obtained by accumulating DIET ions at 473 K, respectively. A comparison of two kinds of image suggested that the hydrogen permeation depends on the grain structure.
There is also a difference in the distribution of hydrogen in one grain, which is a difference in crystal orientation.

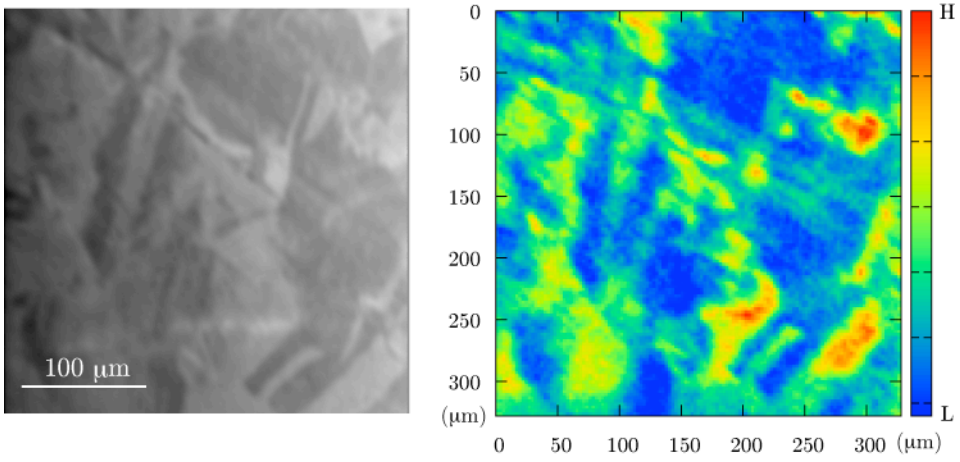

Fig. 2: (a) SEM Image , (b) DIET image of hydrogen which passed through stainless steel.

[1] N. Miyauchi, S. Suzuki, S. Takagi, T. Goto, Y. Murase, A.N. Itakura, J. Vac. Soc. Jpn, **58** (2015) p387