Effects of Ni-Si clusters on loop growth and stability investigated by additional in-situ irradiation

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In irradiated stainless steels, dislocation loops and Ni-Si clusters will be formed and will interact with each other. In this work, irradiated stainless steels with and without pre-existing Ni-Si clusters were additionally irradiated at 400˚C to enhance loop growth. The possible effects of Ni-Si clusters on the growth and stability of loops will be discussed.
Keywords: stainless steel, combined irradiation, in-situ, loops

1. Introduction

Stainless steel is widely applied in light water reactors as structural materials. During its service, dislocation loops and Ni-Si clusters will be formed as a result of irradiation. These two types of radiation defects are expected to interact with each other. For example, Ni-Si clusters may decorate dislocation loops [1], which may increase the stability of loops under irradiation [2]. Besides, Ni-Si clusters and dislocation loops may compete in absorbing interstitials and vacancies. In order to analyze the effects of Ni-Si clusters on loop growth and stability, stainless steel specimens with and without pre-existing Ni-Si clusters were further irradiated with in-situ TEM observation.

2. Experimental

Two model alloys of 316L stainless steel were used in this work. One alloy has no Si contents, which is marked as LS; the other one has 0.95wt.% Si, which is marked as HS. First, both alloys were irradiated to 0.8dpa at 290˚C as bulk. By our previous results, tiny Ni-Si clusters were created in the HS specimen but not in the LS specimen [3]. Then, foil specimens were picked up from the two irradiated bulks by focused ion beam (FIB), and were additionally irradiated by 1MeV Fe^{2+} at 400˚C to ~0.05dpa with in-situ TEM observation.

3. Results and discussions

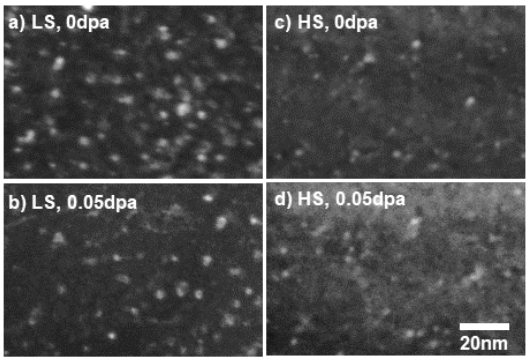

Fig.1 Dark field images (***g***=111) of LS and HS specimens in the additional in-situ irradiation.

Fig.1 shows the typical dark field images at the beginning (0dpa) and the end (0.05dpa) of the additional in-situ irradiation. Tiny black dots and loops with diameter less than 5nm were observed. Loop growth was slow during the in-situ irradiation; however, the change in number density was distinct. Larger fraction of loops disappeared in the LS specimen compared to the HS specimen. The effects of Si and Ni-Si clusters will be discussed.

References

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