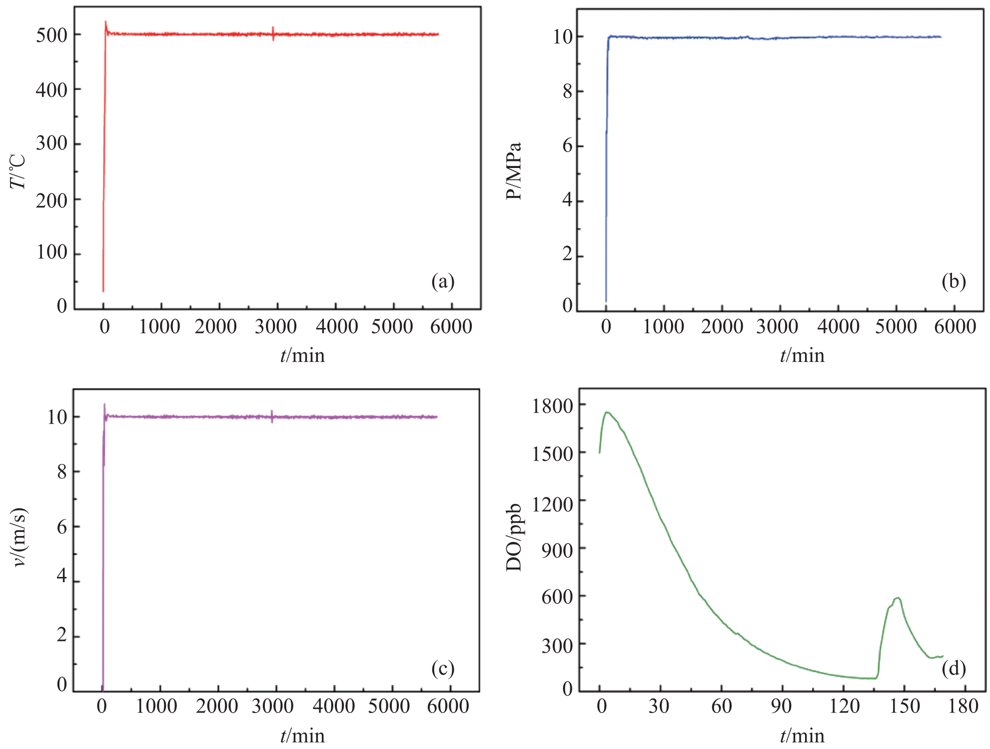

Fig. 1 (color online) The test data. (a) The temperature curve, (b) The pressure curve, (c)The velocity curve and (d) The dissolved oxygen curve.

Reference

[1] S. J. Zinkle, G. S. Was, Acta Materialia, 61(2013)735.

4 - 8 A Study of Precipitation in Martensite Steels Induced by Fe-Ion Irradiation at 300 ℃

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The martensite steels are accepted material used in nuclear power plant. In this study, self-ion irradiation was used to simulate the damage caused by fast neutrons in two kinds of martensite steels, SIMP and T91, under the temperature of 300 ℃. The contrast experiment on the steel samples was carried out with 352.8 MeV Fe-ions.

S parameter is a statistical conclusion about vacancy damage caused by irradiation, and it is positively related to the density of vacancy defects Figs. 1 and 2 show the change of the *S* parameter with the irradiation dose. Whereas Figs. 3 and 4 show the different *S* parameters for two kind of steels.

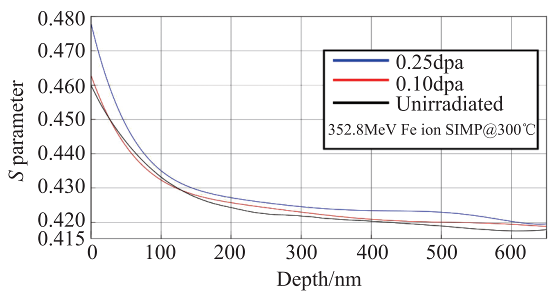

Fig. 1 (color online) *S* parameter varies from dpas of SIMP steels.

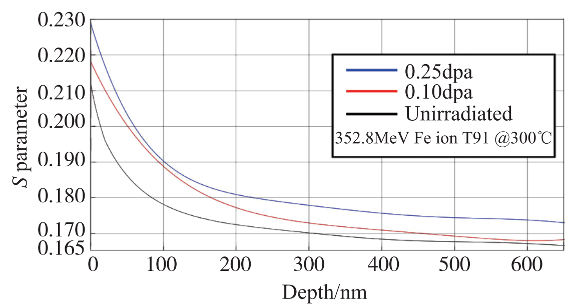

Fig. 2 (color online) *S* parameter varies from dpas of T91 steels.

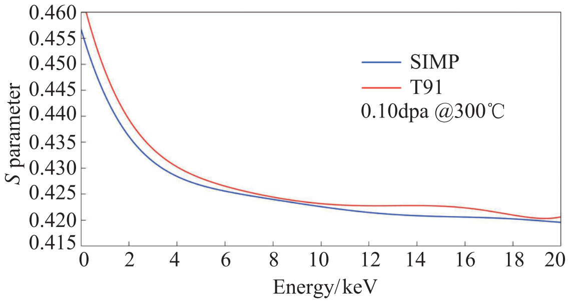

Fig. 3 (color online) S parameter between SIMP and T91 steels in 0.10 dpa.

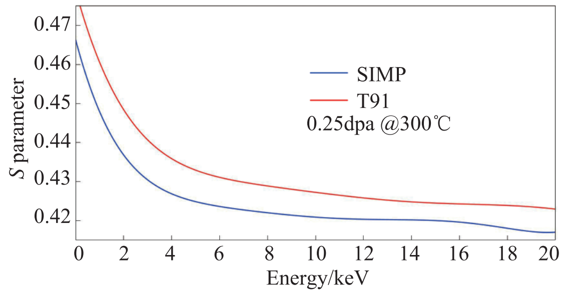

Fig. 4 (color online) S parameter between SIMP and T91 steels in 0.25 dpa.

It is obviously that irradiations lead to the raise of vacancies, as two kind of steels have the similar damage rates. In the same material, the doses, the more vacancy defects, under the temperature of 300 ℃. The differences between SIMP and T91 under the same damage degree show that SIMP has the lower S parameter than T91.

SIMP containing 1.23wt% Silicon has the better radiation resistance in the performance of vacancy defects. Garner propose the fast-diffusing mechanism to explain why Silicon can inhibit the nucleation of vacancies[1−3]. During irradiation, especially under the high temperature, Si has a high mobility. The spreading of Si raises the movement of the vacancies, and then it is difficult for vacancies to nucleate.

Figs. 5 and 6 show the precipitation and dislocation loops were observed by TEM. There are some difference in size and distribution between the irradiation at 300 ℃ and 400 ℃. Uniform precipitate distributed inside the grain. Under 400 ℃, there are a greater number of dislocation loops, and the size of dispersoids is larger. According to the situation of these dislocation loops, it can be inferred that the bypassing mechanism works during irradiation. Dislocation lines go around the grain of second phase, and then dislocation loops formed at the situation.

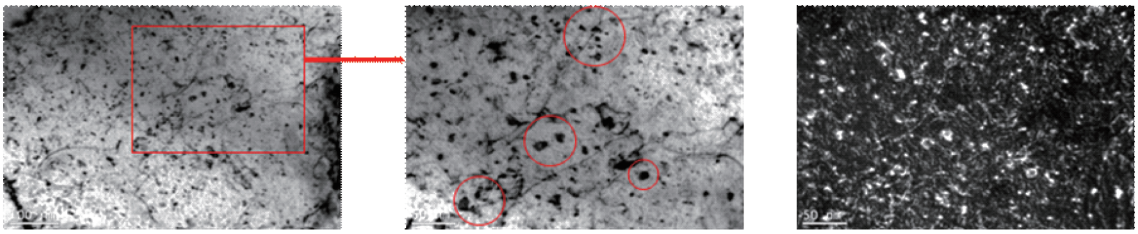

Fig. 5 (color online) The TEM images for SIMP 1dpa@400 ℃.

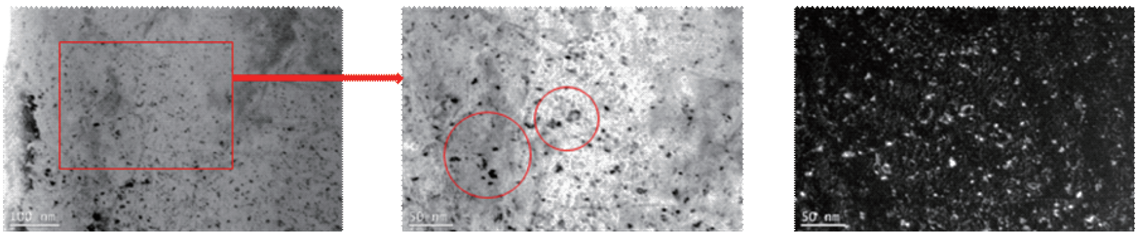

Fig. 6 (color online) The TEM images for SIMP 1dpa@300 ℃.

It is known that dislocation loop is a kind of strengthening for the material of steels. These phenomena tell us that SIMP, at least in micro-structure, has a better irradiation performance.

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