With increasing irradiation dose to 18 dpa, an important feature of cavities-particle complexes is the second-phase particles changing their shape by attached cavities. Typical microstructures of the cavities attached to MC particle are shown in Fig. 1(d). On one hand, the observed shape changing of MC particle by attached cavities suggests that there is a strong binding between particles and cavities[3]. On the other hand, when argon is injected, migrating argon is trapped at particle-matrix interfaces where it stabilizes cavity embryos against shrinkage in the early stages of nucleation[4]. The attached cavity can grow subsequently under argon supply and accumulation of supersaturated vacancies and then it results in the MC particle become truncated by the cavities containing argon under high internal pressure. The observed trapping of both argon and vacancies at the interface of MC particles at 773 K indicates that these MC particles may be able to reduce high temperature helium embrittlement at grain boundaries in a similar way to the effect of Y_2O_3 particles in oxide dispersion strengthened (ODS) steels.

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3 - 6 Microstructure in Martensitic Steels Chinese RAFM and T91 Irradiated with 196 MeV Kr Ions

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Martensitic steels offer some advantages over austenitic stainless steels and are proposed as candidate structural materials in advanced nuclear reactors because of their low activation, superior swelling resistance, excellent mechanical properties, and good microstructure stability. The irradiation of Kr-ion with a kinetic energy of 196 MeV was performed on the high temperature & stress (HTS) materials research terminal of the HIRFL-SSC (IMP, Lanzhou). The materials used in the present irradiation are Chinese reduced activation ferritic/martensitic(RAFM) and Japan T91 steels. After irradiation, the irradiated specimens were prepared with the cross-sectional specimen technique and then thinned for TEM by ion beam milling, so that damage level as a function of depth could be obtained directly. The TEM observation was performed with an FEI TECNAI G^2 F30 TEM at Lanzhou University and all micrographs were taken at 300 keV.

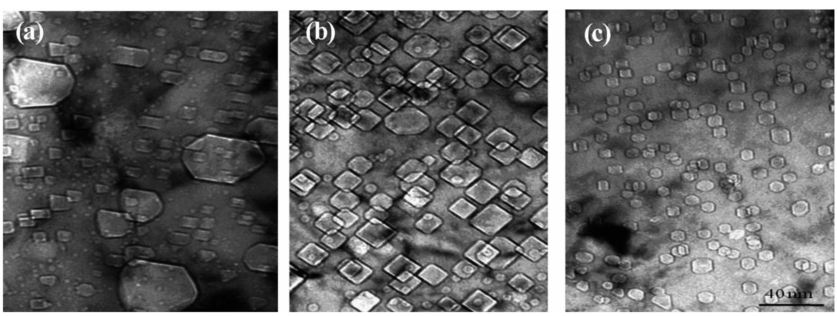

Fig. 1 Microstructure of cavities in Chinese RAFM steel at different irradiation conditions: (a) 31 dpa, RT; (b) 28 dpa, 450 ℃; (c) 31 dpa, 550 ℃.

Figs. 1 and 2 show the microstructure of cavities induced by irradiation at peak damage region in Chinese RAFM and T91 steel at different irradiation temperature, respectively. It is found that dense cavity produced by irradiation mainly located in the martensite lath boundaries, dislocation network and precipitates formed during tempering. The cavities tended to facet strongly onto the low index planes due to their lower surface energy. The maximum cavity swelling (6.6% and 5.2%) occurred in Chinese RAFM and T91 steels irradiated at room temperature. Moreover, typical bimodal cavity size distributions were observed in both Chinese RAFM and T91 steels irradiated with Kr ions at 450 ℃. Base on the microstructural evolution of two different irradiated matensitic steels at the same condition, it reveals that T91 steel have a better irradiation swelling-resistance than Chinese RAFM steel.

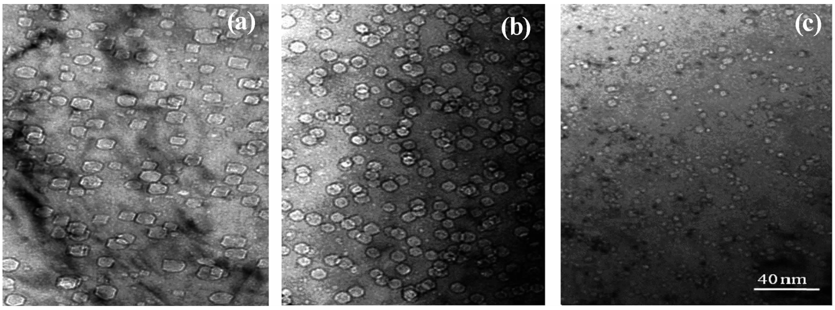

Fig. 2 Microstructure of cavities in Japan T91 steel at different irradiation conditions. (a) 31 dpa, RT; (b) 28 dpa, 450 ℃; (c) 31 dpa, 550 ℃.

3 - 7 Mechanical Properties and Microstructure of 316LN Weld Metal

Li Bingsheng, Dai Yong[1] and Wang Zhiguang

Fig. 1(a) shows the electron beam (EB) welded 316LN plate taken from a mini-tensile sample. The width of the weld zone and heat affected zone (HAZ) is 1 and 0.5 mm respectively. The grain morphology is totally different from the base metal. Fig. 1(b) shows the mean gain size for the base metal is about 55 μm.

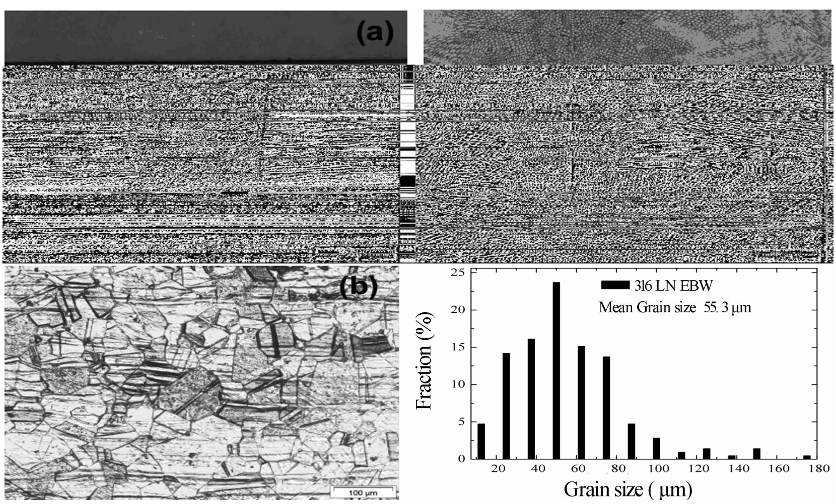

Fig. 1 Metallography morphology of weld zone (a) and base metal (b) and distribution of grain size.

The micro-hardness data were measured perpendicular to the weld center along the line from base metal, HAZ and weld zone, as shown in Fig. 2(a). The hardness value of 316LN base metal is around 170 HV measured with a test weight of 0.2 N. Hardening in the weld metal and the adjacent HAZ is more

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