4 - 10   A Study on Hydrogen-Helium Synergistic Effects in SIMP Steels

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Under Accelerator Driven System(ADS) conditions, large number of hydrogen and helium will be produced through (n, α) and (n,p) reaction, respectively. In the past, there were large studies on the He-implanted materials but less on H-implanted. Because H could not be retained at high concentrations and diffuse out at higher temperature. However, there were past works which find that He-H synergistic effects will enhance swelling and hardness of some F/M steels in a temperature and doses range. Nevertheless, it is not clear that behaviors of SIMP steels which are considered as one of the candidate structural materials under He-H synergistic effects. Therefore, we did a single He$^+$and double beams sequential implanted experiment to study what influence of pre-implanted H$^+$on the nucleation and growth of bubbles at room temperature. Then, ion implanted specimens were investigated by TEM(Fig. 1).
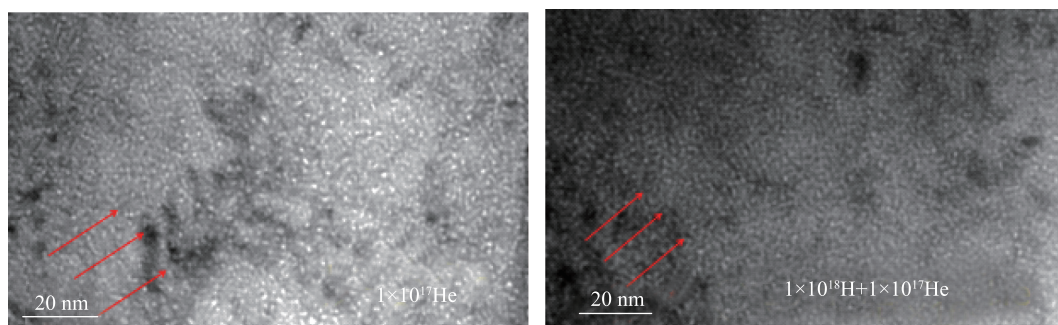

Fig. 1   TEM micrographs of bubble morphology of He$^+$implanted and (H$^+$+He$^+$) sequential implanted SIMP steel samples.

In Fig. 1, we can see that bubble sizes and density in the (H$^+$+He$^+$) irradiated specimens were not apparently changed vs H$^+$irradiated samples, which indicate that there are not obvious H-He synergistic effects in SIMP steels at room temperature. As for higher temperature, it cannot certify. For this, we have done a H$^+$, He$^+$, (H$^+$+He$^+$) and (He$^+$+H$^+$) single beam or double beams sequential implanted at RT, 350 ℃ and 550 ℃ respectively. And hope to understand that He-H synergistic effects in SIMP steels at high temperature in recent days.