Preparation and thermal desorption properties of Titanium–hydrogen-helium thin films

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The behavior of hydrogen and helium in materials is important to fission and fusion reactors. In the fusion reactor, copious quantities of helium will be produced as the "ash" of D-T reactions and go into the surronding structure. Furthermore, the decay of fuel tritium, which will either be absorbed into the wall materials or storaged on the hydride beds, would result in the production of He-3. In order to simulate aging the tritides and investigate the effect of hydrogen on helium behavior in the metal, a new approach for preparing hydrogen and helium co-containing titanium films (Ti-H-He) was developed, in which we applied direct current magnetron sputtering in a mixture of working gases (helium, argon, and hydrogen). The amount and depth profile of helium and hydrogen trapped in the films were determined using an ion beam analysis method called the elastic recoil detection. The microstructure and surface morphology of the Ti-H-He films were studied by X-ray diffraction, transmission electron microscopy, and atomic force microscopy. To investigate the effect of hydrogen on the thermal release behavior of helium in the Ti film, thermal helium desorption spectrometry (TDS) was used, which revealed a similar desorption behavior to aged tritides. TDS experiments showed that the spectra was constituted by low temperature peaks around 300℃ and high temperature peaks above 750℃. Furthermore, the solid-phase α to δ transformation changed the shapes of the high-temperature peaks related to microstates of helium bubbles, and caused the peak with a massive helium release shift toward lower temperature obviously.