3 - 11 Corrosion Behavior of T91 Steel in Static Lead-bismuth Eutectic at 450 ℃

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Accelerator Driven Sub-critical System(ADS)is considered to be a powerful tool for treating radioactive nuclear waste and for effectively utilizing nuclear energy resources[1-2]. Because its low melting point (125 ℃), high boiling point (1670 ℃), low saturated vapor pressure, and high neutron yield, LBE can be used as the coolant and the spallation target for ADS[3].

Although LBE has many advantages, its disadvantage should be not neglected, for example, liquid metal corrosion, oxidation and corrosion-induced element segregation. Therefore it has been gotten wide attention in some laboratories, like KIT, Los Alamos national laboratory, ENEA, PSI [4-8]. In order to investigate the corrosion behaving of several candidate materials for ADS, the corrosion test was carried out in static LBE corrosion equipment designed by us, as shown in Fig. 1. The test materials are four kinds of martensitic steels, T91 made in Japan, T91 made in china, SIMP-4 and SIMP-6 fabricated by Institute of Modern Physics, Chinese Academy of Sciences cooperated with Institute of Metal Research, Chinese Academy of Sciences. The test samples of these materials were exposed in LBE (55 wt. % Pb + 45 wt. % Bi) at 450 ℃ for 500, 1000 and 2000 h, respectively. After LBE corrosion, the samples were cleaned carefully. Cross-section samples were prepared in order to observe the corrosion layer by scanning election microscope (SEM) equipped with an energy dispersive X-ray spectroscopy (EDX).

Fig. 1 The static LBE corrosion equipment.

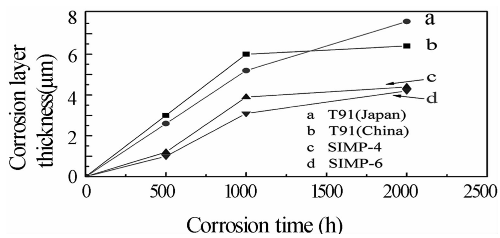

Fig. 2 The thickness of corrosion layer vs the corrosion time

The changes of corrosion layer thickness of the samples with corrosion time are presented in Fig. 2. It is clear that the corrosion layer thickness increases with the increasing the corrosion time. After corrosion for 1000 h, the corrosion rate is tending to decrease with increasing the corrosion time. Under the same corrosion condition, SIMPs have better corrosion resistance than that of T91 steels.

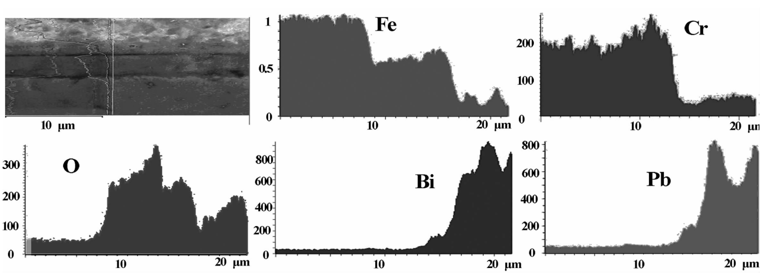

Fig. 3 Oxide layers formation and typical element distributions (along the EDX linescan traces maked in the SEM micrograph) near the surface of T91. The T91 sample was in LBE for 2000 h at 450 ℃.

Oxide layers formation (see SEM micrograph) and typical element distributions of the region near the sample's surface analyzed by EDX are given in Fig. 3. Two oxide layers with different contrasts near the sample's surface after 2000 h were obviously observed. EDS analysis of T91(Japan) shows that the corrosion layer can be divided into two layers. The contents of Fe and Cr are higher in the layer closed to the substrate layer; the content of Cr decreases in the corrosion layer away from the substrate, in the meantime there was a small amount of Pb and Bi penetration in the corrosion layer.

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3 - 12 Damage Production in $LiTaO_3$ Crystal Induced by H- and He-ions Implantation

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Lithium tantalate ($LiTaO_3$) is an important multi-functional material because of its excellent piezoelectric, ferroelectric, acousto-optic and electro-optical effects[1]. Recently, this kind of crystal exhibits a promising prospect for optical waveguide fabrication by light ion implantation[2]. In this work, we will focus on the damage induced by H/He ions implantation in the $LiTaO_3$ single crystal.

Z-cut $LiTaO_3$ were implanted by 100 keV H-ion and He-ion at the fluences of 1.0×10^{16} and 1.0×10^{17} ions/cm^2, respectively. Fig. 1 shows the transmission spectra of the samples at different fluences. When the implantation reaches a certain fluence, the transmittance decreases in the visible region and the near-UV region. This indicates that great many point defects of oxygen vacancies are produced in the crystal, which results in a strong optical absorption near the 460 nm[3]. It also can be found that the optical absorption induced by H-ion implantation is more intense than that induced by He-implantation. This implies that H-ion implantation created more oxygen vacancies in the crystal.

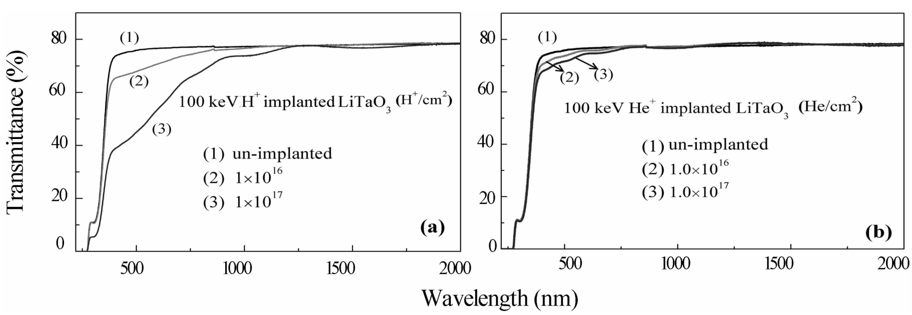

Fig. 1 The transmission spectra of samples at different fluences.

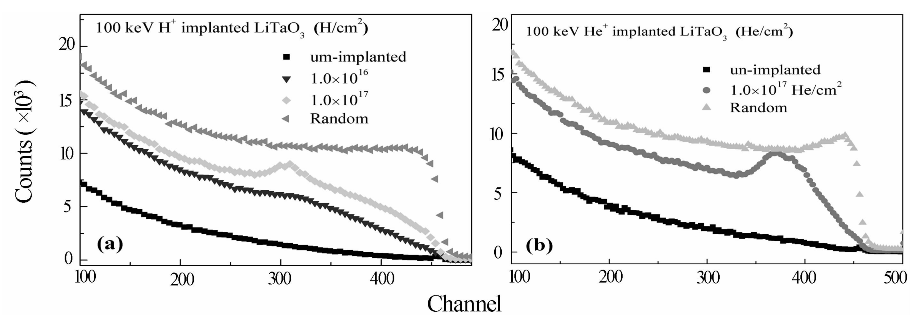

Fig. 2 The Rutherford backscattering-channeling spectra of samples at different fluences.