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CORROSION PROPERTIES OF ZIRCONIUM IRRADIATED BY LOW-ENERGY HIGH-CURRENT ELECTRON BEAM*

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Attractive properties, such as low neutron absorption, good corrosion resistance, and a satisfactory combination of ductility and strength, have made it possible to widely use Zr alloys in the chemical and nuclear industries [1–3]. To obtain optimal surface properties of Zr alloys, attempts were made to use various surface treatment methods, such as ion implantation [4], microarc oxidation [5], laser surface melting [6], etc.

As another method of material surface modification, low-energy high-current electron beam (LEHCEB) has attracted wide attention due to its great application potential and advantages [7]. When irradiated with LEHCEB, high energy can be released in the surface layer in a very short time and produce extremely fast heating, melting and even evaporation, then rapid cooling through the thermal conductivity of the sample. The dynamic stress fields caused by the rapid cooling process lead to intense modifications that can propagate in the material up to several tens of microns in depth. Accordingly, special modification effects can be achieved and, as a consequence, the corrosion properties of the material can be improved [8, 9].

Fig. 1,a shows the polarization curves in a 3.5% NaCl solution to compare the corrosion resistance between the original and irradiated samples. After LEHCEB irradiation, a wide area of primary passivity is visible, as well as an increase in the corrosion potential. Fig. 1, b also shows the SEM image of the Zr surface of the corrosion experiment. Pits with an interesting broken pattern appeared over the entire area of impact of the solution.

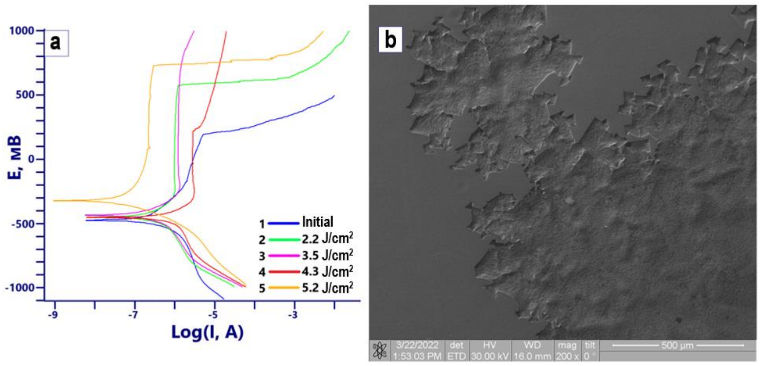

Fig. 1 – Potentiodynamic polarization curves (a) of Zr before and after irradiation with LEHCEB and SEM image (b) after the corrosion experiment.

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