


ABSTRACT

Impact of heat treatment on the structural and mechanical properties of Zircaloy-4 was investigated in this work. The samples of the Zircaloy-4 were given heat treatment at different temperatures (650, 700, 750, 800 and 850°C for one hour) in air using a muffle furnace. The structural analysis of the pristine and heat-treated samples was carried out to determine the texture co-efficient, crystallite size, and micro-strain of the samples. The results showed Zr peaks along various planes both in pristine and heat-treated samples. The intensities, full width at half maximum and 2 theta values of the Zr peaks were changed with increase of the temperature. Intensity of the Zr peaks was significantly decreased after the heat treatment. For the evaluation of crystallite size and micro-strain, the Williamson-Hall analysis of the data was carried out. The crystallite size showed a decreasing trend with increase of the temperature. Similarly, the micro-strain followed opposite trend to that of the crystallite size. The Vickers hardness of the Zircaloy-4 was increased with increase of the temperature to 800°C and then decreased with further increase of the temperature. The tensile tests of Zircaloy-4 samples revealed an increase in the strength of the material with increase of the temperature. During the tensile tests, the cross-head of the universal testing machine was stopped at regular intervals to observe the relaxation of stress with time. The stress-relaxation curves of the Zircaloy-4 were obtained both for the pristine and the heat-treated samples. The slope of these curves was calculated to determine the stress relaxation rate. The stress relaxation rate increased linearly with increase of the initial stress levels. The activation energy was calculated using the single barrier model of stress relaxation. The activation energy was increased with increase of the temperature up to 700°C and then decreased with further increase of the temperature. The changes in the mechanical properties of the Zircaloy-4 were explained on the basis of changes in crystallite size as well as the precipitates formation in the material.  (Ctrl) ▾