Radiation Effects on Metals, Alloys and Cement

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High - energy particle irradiation of materials brings as a consequence changes in their atomic structures that alter the electrical, magnetic and mechanical properties which are the most important characteristics for practical applications of metals and alloys. A review is made on experimental results of in-pile (IEA-RI reactor) and CV-28 cyclotron irradiated materials. Resistivity measurements on CuPd an FeNi alloys showed different behaviour during fast neutron irradiation. While CuPd had almost coincidental relaxation curves, FeNi presented a distinguishable short and long-range ordering with the critical order-disorder temperature at 515°C. Vacancy supersaturation curves of FeNiSi (49-49-2 at.%), FeNiCr (49-95-49.95-0.1 at.%), FeNiMo (50-50 at.% + 50 ppm) and pure FeNi (50-50 at.%), determined by means of the Magnetic After Effect are presented as an effective pre-selection method of nuclear materials before the destructive stage of void formation and swelling. A displacement of damage peak from 480 to 500 and 570°C was detected on pure AISI 321 stainless steel and with 0,05 wt.% and 0,10 wt% of Nb additions by means of resistivity and micro-hardness. Ultrasound techniques applied to fast neutron irradiated portland cement paste (fluency $7{,}2 \times 10^{18}$ n/cm^2) showed a 24% decrease in its dynamic elasticity modulus. Helium diffusion on Au, Ag and Al foils irradiated in cyclotron was studied, suggesting a vacancy mechanism for single He atom diffusion. Embrittlement by Alpha particle implantation in cyclotron - to simulate in-pile (n,α) reaction-was measured by high temperature creep on AISI 316 stainless steel.