OXYGEN EMBRITTLEMENT OF VANADIUM ALLOYS WITH AND WITHOUT SURFACE OXIDE FORMATION -- B. A. Pint and J. R. DiStefano (Oak Ridge National Laboratory)

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EXTENDED ABSTRACT

Specimens of V-4Cr-4Ti were exposed to low pressure oxygen and high purity He environments from 1atm down to 10^{-4}atm in order to determine oxidation kinetics at 600°-700°C and effects on mechanical properties at 25° and 600°C. At lower oxygen pressures ($P_{O_2} \leq 10^{-5}$Pa), linear reaction kinetics were measured for exposures up to 2000h and the data was used to develop a mathematical expression for the oxidation rate (r in units of mg/cm^2) under these conditions as a function of temperature (T in K) and oxygen pressure (in Pa):

$$r = 4.7 \times 10^{2} \bullet e^{-821/T} \bullet P_{O_2}$$

At higher oxygen pressures, linear-parabolic reaction kinetics were associated with high oxygen uptake and the formation of an external oxide layer. Room-temperature and 600°C tensile ductility was reduced by these exposures, but specimens which formed an external oxide retained some tensile ductility after exposure even though the total oxygen uptake was relatively large. However, when similar specimens with an external oxide were subsequently annealed for 2000h at 700°C the oxide layer disappeared and the specimens were severely embrittled, Figure 1. These results suggest that a surface oxide on V-4Cr-4Ti can be a source of oxygen for subsequent internal dissolution and, therefore, does not prevent embrittlement in extended exposures at 700°C.

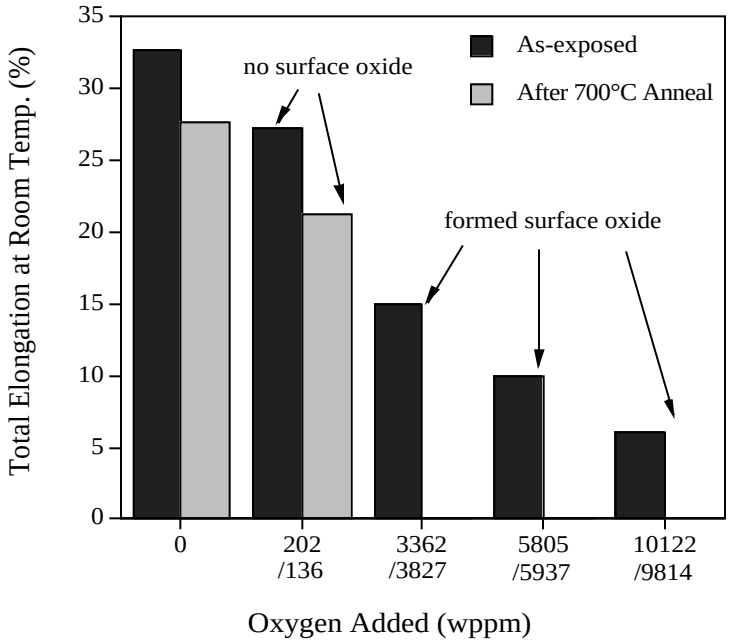

Figure 1. Total elongation at room temperature as a function of added oxygen with and without annealing for 2000h at 700°C. V-4Cr-4Ti specimens which formed a surface oxide and were annealed (3827, 5937 and 9814ppm O) were severely embrittled and had zero ductility.