LONG TIME OXIDATION STUDY OF Ti_3SiC_2, Ti_3SiC_2/SiC and Ti_3SiC_2/TiC COMPOSITES IN AIR

by
M. W. Barsoum, L. H. Ho-Duc, M. Radovic and T. El-Raghy
Dept. of Materials Engineering
Drexel University, Philadelphia PA 19104

In this paper we report on the oxidation kinetics and morphology of the oxide phases that form after long term (up to 1500 hrs.) oxidation in ambient air of fine and coarse-grained samples of Ti_3SiC_2, Ti_3SiC_2 with 30 vol. % TiC and Ti_3SiC with 30 vol. % SiC in the 875 to 1200 °C temperature range. In all cases, the oxidation resulted in a duplex scale; an outer rutile and an inner rutile/silica layer. Comparison with previously published results indicate the rate limiting step to be the inward diffusion of oxygen and the simultaneous outward diffusion of titanium. The results also strongly suggest that the activation energies for diffusion of *both* oxygen and titanium in rutile are almost identical over at least the 1000 to 1200 °C temperature range. At 875 °C, and up to 100 hrs., the oxidation kinetics of the Ti_3SiC_2 - 30 vol. % TiC samples are parabolic; at 925 °C, and up to 500 hrs., the oxidation kinetics of the Ti_3SiC_2 - 30 vol. % SiC are subparabolic. The oxidation kinetics of all other runs are initially parabolic, but at times longer than ≈ 30 to 100 hrs. depending on temperature, they become linear. The reason for the transition is not entirely clear, but could be due to the buildup of stresses in the external oxide scales. The technological implications of these results and how the oxidation behavior can be enhanced by order of magnitude by silicidation will be discussed.