The oxidation behavior of Ti–14Al–21Nb in air and in oxygen was determined over the temperature range 700 to 1000°C. Weight gains in both atmospheres were measured using thermogravimetric analysis. The resulting oxidation products were identified using X-ray diffraction, and oxide morphology was evaluated using electron microscopy and wavelength-dispersive X-ray analysis. Total weight gains in oxygen were up to four times higher than in air, and a higher percentage of the weight gain in oxygen was due to oxygen dissolution into the metal. Based on metallurgical examination of the oxidized specimens, it was concluded that the lower oxidation weight gains in air are due to the formation of a thin layer of TiN and TiAl at the oxide–metal interface which inhibits the diffusion of oxygen into the metal.

KEY WORDS: oxidation; titanium aluminide; air; oxygen.

INTRODUCTION

Titanium–aluminide intermetallic alloys, such as the \( \alpha_2 \)-base alloy Ti–14Al–21Nb, are candidate materials for use in hypersonic structures and advanced engines because of their high specific strength and excellent high-temperature properties. These alloys, however, have poor resistance to both oxidation and oxygen embrittlement at high temperatures. Understanding of the oxidation process of these alloys is necessary before development of protective coatings can be accomplished.
One aspect of the oxidation of α₂-base alloys that has received limited attention is the role of gas composition. One study on the oxidation of pure titanium and titanium alloys showed that these metals oxidized slower in air than in oxygen. That study concluded that the slower oxidation rates in air were due to the presence of nitrogen, which tended to concentrate at the oxide–metal interface due to the higher diffusion rate in the oxide compared to that in the metal. The limited number of studies of this nature on titanium aluminides, however, have focused on the ability of these alloys to form a protective alumina scale in various environments. While it was shown that nitrogen in air suppresses the formation of alumina on γ-alloys, the α₂-alloys were not found to form protective alumina in either air or oxygen.

The purpose of the present study, therefore, was to compare the oxidation behavior of the α₂-base alloy Ti–14Al–21Nb in air and in oxygen. Samples were oxidized in air and oxygen over the temperature range of 700 to 1000°C using a thermogravimetric apparatus (TGA). The oxide composition and morphology of selected samples were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), and wavelength dispersive X-ray spectroscopy (WDS).

**EXPERIMENTAL PROCEDURES**

**Specimens and Materials**

Specimens for oxidation tests were prepared from Ti–14Al–21Nb with the following composition in weight percent: 13.5 Al, 21.1 Nb, 0.03 Fe, 0.061 O, 0.001 N with the remainder Ti. The starting sheet material, which was approximately 0.127 cm in thickness, was heat treated for 1 hr at 950°C in vacuum to stabilize the microstructure.

TGA samples were machined to the dimensions of 1.0 cm wide, 1.5 cm long, with a 0.16-cm-diameter hole through the thickness at one end for suspending the sample during the test. Surfaces of samples were ground to a uniform finish using silicon carbide paper through 1200 grit. Samples were detergent cleaned, ultrasonically cleaned in acetone and ethyl alcohol, and air-dried. The dimensions of finished samples were measured to the nearest 0.001 cm and weights were recorded before and after exposure to the nearest 0.01 mg.

**Oxidation Tests**

Oxidation tests were conducted in air and oxygen from 700 to 1000°C for times up to 100 hr. The sample weight change was recorded continuously during exposure using a Cahn C2000 microbalance with an accuracy of 1 μg. Samples were suspended by quartz fibers within a mullite tube inside a