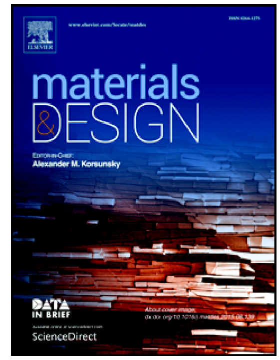
Accepted Manuscript



Synthesis of metal-intermetallic laminate (MIL) composites with modified Al3Ti structure and in situ synchrotron X-ray diffraction analysis of sintering process

D.V. Lazurenko, I.A. Bataev, V.I. Mali, A.M. Jorge, A. Stark, F. Pyczak, T.S. Ogneva, I.N. Maliutina

PII:	S0264-1275(18)30308-3
DOI:	doi:10.1016/j.matdes.2018.04.038
Reference:	JMADE 3851
To appear in:	*Materials & Design*
Received date:	23 January 2018
Revised date:	12 April 2018
Accepted date:	13 April 2018

Please cite this article as: D.V. Lazurenko, I.A. Bataev, V.I. Mali, A.M. Jorge, A. Stark, F. Pyczak, T.S. Ogneva, I.N. Maliutina , Synthesis of metal-intermetallic laminate (MIL) composites with modified Al3Ti structure and in situ synchrotron X-ray diffraction analysis of sintering process. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jmade(2017), doi:10.1016/j.matdes.2018.04.038

Synthesis of metal-intermetallic laminate (MIL) composites with modified Al_3Ti structure and in situ synchrotron X-ray diffraction analysis of sintering process

D.V. Lazurenko[1*], I.A. Bataev[1], V.I. Mali[2], A.M. Jorge Jr.[3,4,5], A. Stark[6], F. Pyczak[6], T.S. Ogneva[1], I.N. Maliutina[1]

[1]Novosibirsk State Technical University, 630073, Russia, Novosibirsk, Karl Marks str. 20
[2]Lavrentiev Institute of Hydrodinamics, SB RAS, 630090, Russia, Novosibirsk, Lavrentiev av. 15
[3] Federal University of São Carlos, Via Washington Luiz, Km 235, 13565-905, São Carlos, SP, Brazil
[4]Université Grenoble Alpes, SIMAP, 621 avenue Centrale 38400 Saint-Martin-d'Hères
[5]Université Grenoble Alpes, LEPMI, 621 avenue Centrale 38400 Saint-Martin-d'Hères
[6]Helmholtz Zentrum Geesthacht, Max-Planck-Straße 1, 21502 Geesthacht, Germany
*corresponding author: pavlyukova_87@mail.ru, +79232455243

Abstract

Al_3Ti-based alloys attract exceptional attention due to their high specific mechanical properties. However, their application is still insufficient due to their low ductility and fracture toughness. Several approaches were previously proposed to address these problems. The first one is stabilization of the cubic modification of titanium trialuminide by alloying. Another approach consists in fabricating metal-intermetallic laminated composites (MIL). In this study, we combined both methods to synthesize the first MIL composite with cubic Al_3Ti interlayers. Copper additions were used to stabilize the cubic modification of Al_3Ti and produce a novel Ti-Al_5CuTi_2 MIL composite. First mechanical characterization by indentation tests showed that the binary Al_3Ti intermetallic tended to crack at a load of 0.2 kg while the fracture was not observed in the Al_5CuTi_2 layers at least at a load of 1 kg. These results are an indirect evidence of a higher ductility and fracture toughness of the composite with cubic Al_3Ti compared to tetragonal one. The sequence of the phase transformations in the Al-Ti-Cu system was studied using in situ synchrotron X-ray radiation diffraction. The formation of Al_5CuTi_2 occurred via several intermediate stages including eutectic melting of Al and Cu and the formation of binary AlCu and Al_3Ti compounds.

Keywords: sintering; titanium aluminide; phase transformation; synchrotron diffraction; fracture toughness; ternary compound

1. Introduction

Over the last few decades, ordered intermetallic alloys are in the focus of considerable research interest. As a rule, these materials possess excellent strength, hardness, low density and perfect oxidation resistance at high temperatures [1], which makes them promising candidates for aerospace applications, e.g., for producing elements of jet engines. Among various groups of intermetallic alloys, the system Ti-Al is of keen interest. Ti-Al intermetallics are qualified among the most advanced materials due to their outstanding combination of properties, such as high strength, chemical durability, and reasonable cost. In the category of binary Ti-Al alloys, three types of compounds (namely, Ti_3Al, TiAl, and Al_3Ti) attract the most exceptional attention. While Ti_3Al and TiAl-based alloys have already found application in the industry, Al_3Ti-based alloys are, so far, still at the research and development stage. At the same time, among the above intermetallics, titanium trialuminide possesses the highest corrosion and oxidation resistance as