# Thermal stability of tungsten and SiC with or without diffusion barrier (ZrN and TiN) at 1700 °C

*Yina Du, Junyeab Lee, Kanjiro Kawasaki, Fujio Shinoda and Tatsuya Hinoki
Kyoto University

Abstract (approx. 55words)

To select an effective diffusion barrier for W and SiC system to fabricate SiC fiber reinforced W composites without reactions, nitrides (ZrN and TiN), from sputtering method and dipping method, were chosen as diffusion barrier. The results show nitrides coated by sputtering method can prevent the solid reaction successfully.

**Keywords:** thermal stability, W, SiC, diffusion barrier

## 1. Introduction

SiC fiber was selected as reinforcement to strength W because of high high-temperature strength, stability to neutron irradiation and close coefficients of thermal expansion between W and SiC. However, severe interfacial solid-state reactions happened after high temperature sintering, generating carbides and silicides. Then, the damaged SiC fiber and low content of remained W will bring about low thermal conductivity and low mechanical property. Therefore, an effective diffusion barrier is very essential for SiC and W composites. TiN shows very high melting point (2930 °C) and exhibits thermodynamic stability to W. Another UHTCs ZrN is chosen for comparison.

## 2. Experiment

Nitrides coating on CVD-SiC by sputtering method generating from metals (Ti and Zr) annealed in $N_2$ at 1400 °C for 2h. C is deposited first before metals to avoid the reactions between metals and SiC. And dipping coating method still was utilized owing to its low-cost and easy to coat on the inner side fiber's surface. Subsequently, to examine the nitrides coating can work or not, a sandwich stack was joined by coated CVD-SiC and W foils at the same sintering condition as SiCf/W composites, namely 1700 °C for 1h with 20 MPa to simulate the sintering procedure. And no coating SiC was still used as control group. Microstructure was examined by scanning electron microscope (SEM) and transmission electron microscope (TEM).

## 3. Results

The depth of reaction zone for the samples without diffusion barrier is about 40 μm, and the sputtered nitrides can impede the reaction successfully, although part of reaction zone still can be found. But dipped nitrides cannot work well because of the cracks after nitriding. The depth of reaction zone for dipped TiN and ZrN are about 42 μm and 35 μm, respectively.

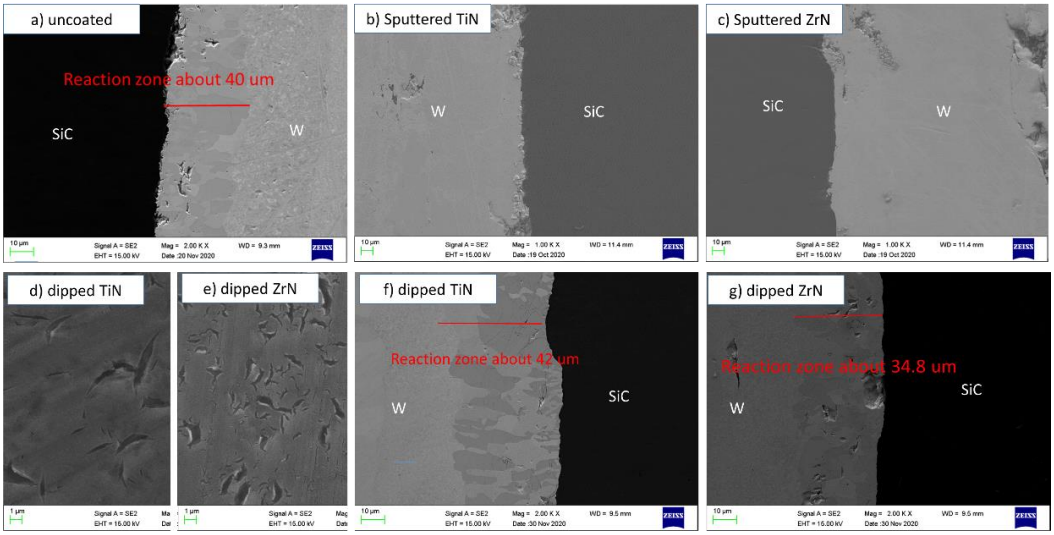


Fig. 1 SEM images about surface of dipped nitrides and cross-section of joined W and SiC with or without coating