[C7]

Processing of Functionally Graded Materials via Green Tape Lamination

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Introduction

Currently, functionally graded materials (FGM) are processed mainly via powder metallurgy routes, i.e., stacking of powders with graded compositions. This process requires many processing steps that include preparation of powder mixtures with different compositions, laying-out of those powder mixture, compaction, followed by sintering. In this study, therefore, an attempt was made to develop a route that reduces the processing steps by using green tapes. Figure 1 shows the schematics of the processing methods of this study.

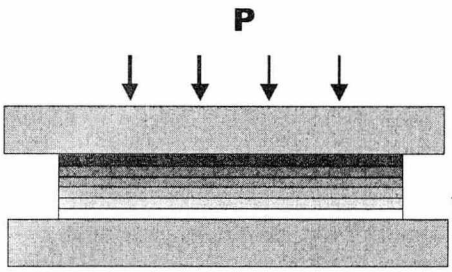

Fig. 1.Schematics of FGM manufacturing by green tape lamination.

Experimental Procedure

ZrO_2 and $MoSi_2$ powders were used for the processing of FGM. The powders were mixed with solvent and dispersant to prepare slurries for tape casting. After the first stage mixing, binder and plasticizer were mixed with the suspension and green tapes were manufactured by casting the slurry using a doctor blade type tape caster. After drying, the green tape was laminated using a rolling machine and sintered to form the FGM.

Results and Discussion

Figure 2 shows SEM images of FGM in green state. The gradient in chemical composition was changed by varying the number of layers stacked. As noted from the figure, green tapes of ZrO_2 and $MoSi_2$ powders laminated alternatively were bonded well together by the lamination. Figure 3 shows SEM micrographs of sintered FGM. The layer densified fully is ZrO_2 layer and that contains micro-pores is $MoSi_2$. Apparently, the difference in sintering characteristics of two materials has resulted in the lack of densification in $MoSi_2$

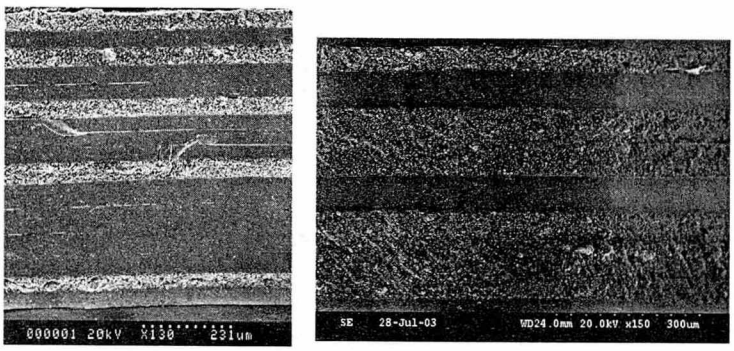

Fig. 2. SEM images of FGM in green state

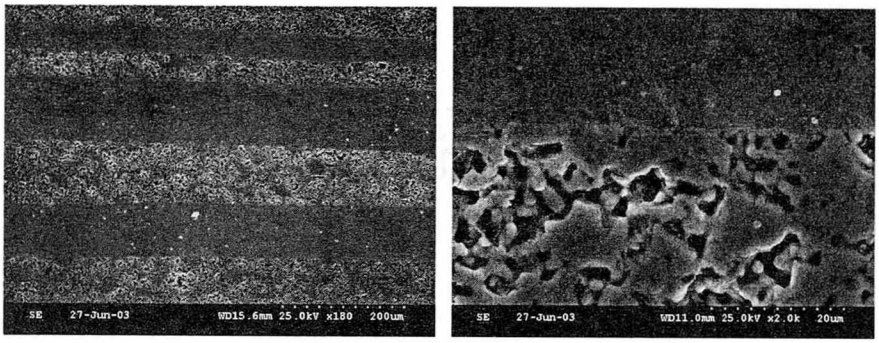

Fig. 3. SEM micrographs of sintered FGM

which sinters at higher temperature than ZrO_2. The results, however, have demonstrated a possibility of using green tapes in the fabrication of FGM.

Summary

A functionally graded material was produced by laminating green tapes. The lamination resulted in the formation of functionally graded structure and sintering of the materials resulted in the formation of FGM. This results demonstrated a possibility of using green tapes in the processing of functionally graded materials.