LOW-COST C-C COMPOSITES FOR ELECTRONIC PACKAGING APPLICATIONS

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INTRODUCTION

Recent advances in microelectronics require the use of low-cost, low-CTE, high thermal conductivity materials [1]. Recently, a new low-cost, low CTE, high thermal conductivity Carbon-Carbon (C-C) composite was developed [2]. Long term dielectric insulation presents a key problem with the use of this new composite as a substrate material. On the other hand, AlN possesses good dielectric and thermal properties, but its high cost greatly hinders its commercial applications [3].

The use of CVD to produce AlN thin films resulted on amorphous, poor quality deposits [4]. This paper describes the deposition of adherent, crack-free CVD AlN coating on a low-cost, high thermal conductivity substrate.

EXPERIMENTAL

The low-cost, high thermal conductivity C-C substrate was fabricated using the procedure described elsewhere [3]. Hot wall CVD was used to deposit both carbon and AlN thin films. Carbon intermediate layer was obtained via methane decomposition, while AlN thin films were produced via a reaction of $AlCl_3$ with NH_3. The AlN thin films were evaluated by XRD, SEM, TEM and XPS to determine their chemistry, morphology and microstructures.

RESULTS AND DISCUSSION

Figure 1 shows a SEM micrograph of AlN thin film deposited directly on the low-cost C-C composite. Due to the CTE mismatch between the substrate and coating tensile cracking is observed.

Figure 2 shows a SEM micrograph of AlN thin film deposited on the CVD carbon coated C-C composite. No cracking is observed combined with fine-grain morphology.

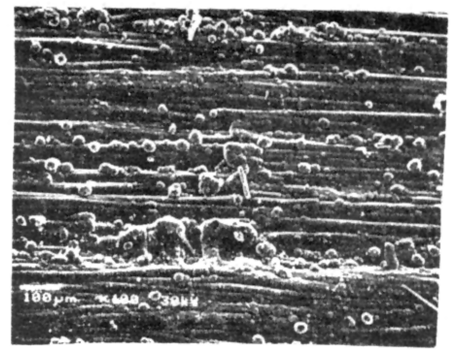

Figure 1. SEM of AlN thin film on a low-cost C-C composite.

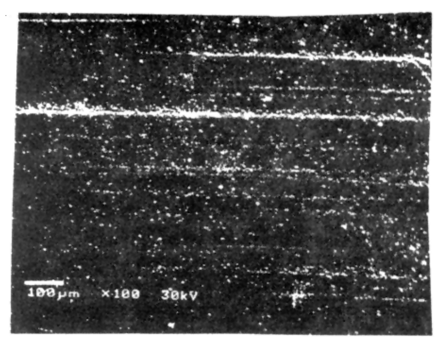

Figure 2. AlN deposited on carbon coated C-C composite.

Figure 3 shows high-resolution SEM of AlN coating corresponding to Figure 2. Well-developed, about 1μ grains are observed.

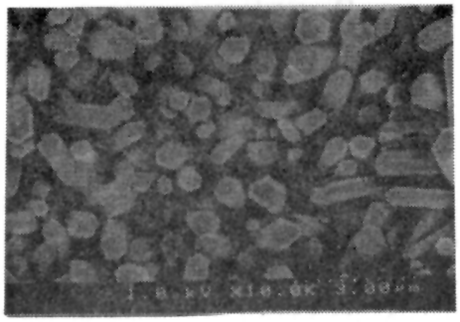

Figure 3. High-resolution SEM of AlN thin film.

High resolution-TEM, Figure 4 shows the lack of substructural defects, while microdiffraction pattern, Figure 5, confirms the presence of crystalline AlN.

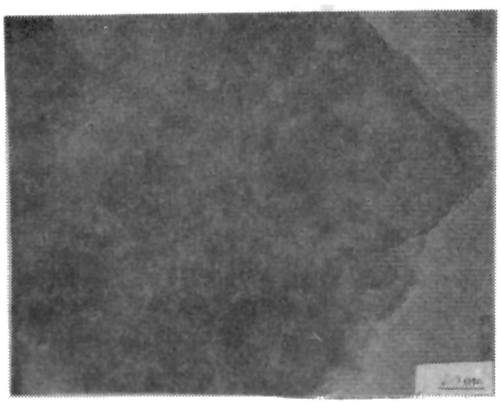

Figure 4. High resolution TEM of AlN thin film.

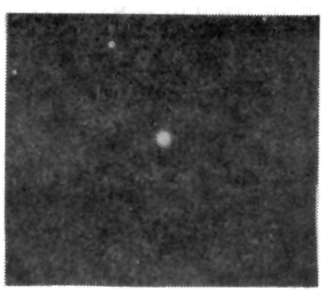

Figure 5. Microdiffraction pattern corresponding to Figure 4.

The use of ultra-thin window EDS, Figure 6, confirmed the presence of stoichiometric AlN with no presence of oxygen. The presence of stoichiometric AlN was also confirmed by XRD, Figure 7, while XPS yielded 1:1 ratio of Al/N.

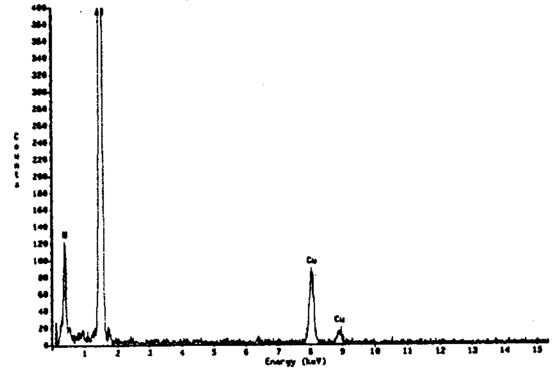

Figure 6. Ultra-thin window EDS spectrum of AlN.

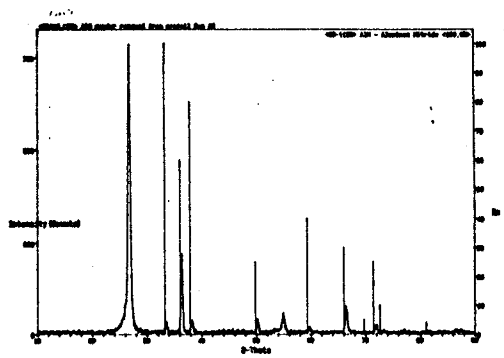

Figure 7. XRD spectrum of AlN.

In summary, this work reports the deposition of stoichiometric, crystalline, crack-free AlN thin films deposited directly on a low-cost C-C substrate. Thus, the deposition of AlN may possibly provide for the application of low-cost C-C composites in chip-on-board applications.

Acknowledgment.

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