Epitaxial relationship of Cu_3N grown on YSZ(001) substrate by mist CVD method

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Copper nitride (Cu_3N) is Anti-ReO_3 type cubic structure. It is reported that the bandgap energy of single crystal Cu_3N is about 1.4 eV and this can be applied as a solar energy conversion material [1]. Cu_3N has typically grown by physical vapor deposition (PVD) using vacuum pressure [2]. Mist chemical vapor deposition (mist CVD) method is one of the cost-effective growth techniques and is possible to grow in atmospheric pressure [3]. Recently, we have succeeded in the epitaxial growth of Cu_3N on *c*-plane sapphire by mist CVD method using NH_3 aqueous solution as a solvent. The epitaxial relationship in in-plane direction of this Cu_3N film was $Cu_3N(100)//\alpha\text{-}Al_2O_3(11\text{-}20)$. This indicates that the film had multi-domain structure, since α-Al_2O_3 has not cubic but corundum structure. [4]. In this study, Cu_3N was grown on a YSZ(001) substrate by mist CVD method. The epitaxial relationship was evaluated.

Cu_3N thin film was grown on a YSZ(100) substrate by vertical-type mist CVD method. Copper (II) acetylacetonate was used as a source material for the growth. The Cu (II) acetylacetonate was solved in NH_3 aqueous solution of 28%. The concentration of Cu was 0.1 mol/L. The mist, formed by the 2.4 MHz ultrasonic transducer, was transferred to the reaction area by nitrogen carrier gas. The Cu_3N film was grown totally for 2 hours at the temperatures of 300°C.

The XRD θ-2θ pattern, shown in Fig. 1(a), indicates that the film has the epitaxial relationship of $Cu_3N(001)//YSZ(001)$ in the growth direction. The XRD ϕ scan patterns, shown in Fig. 1(b), indicates that the film has the epitaxial relationship of $Cu_3N(100)//YSZ(100)$ in the in-plane direction. Thus, we have succeeded in the suppression of multi-domain structure, which is observed in the growth on α-Al_2O_3, using the YSZ substrate with cubic structure.

In the presentation, different growth phenomena for Cu_3N on α-Al_2O_3 and YSZ substrates are also discussed.

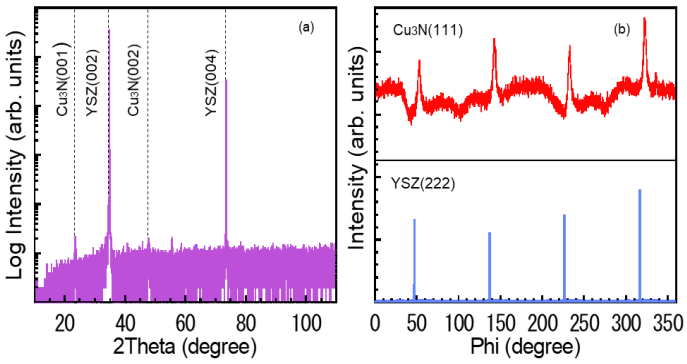

Figure 1. (a) θ-2θ pattern of Cu_3N grown on YSZ (100), (b) ϕ scan patterns of Cu_3N (111) and YSZ (222).

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