Fabrication of YSZ Thin Film on $(Sm_2O_3)_{0.1}(CeO_2)_{0.8}$ Substrate by CVI Method

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The authors have developed an EVD method that utilizes porous NiO as oxygen source and substrate.[1, 2] Its growth rate of YSZ thin film was as low as 4 μm h^{-1}. Films thinner than 5 μm are not tough enough for handling. To enhance the toughness and thickness the method was devised, i.e., a solid substrate was changed from NiO to 20mol% samaria-doped ceria (SDC20), which shows higher oxide-ion conductivity and mechanical strength.

In this study deposition mechanism of YSZ on SDC20 substrate was also discussed including in chemical vapor infiltration (CVI) method.[3].

An SDC20 powder was prepared by Petchini method.[4] The powder was pressed at 250 MPa to form pellets as substrates and sintered at 1600℃ for 18hrs.

Fig.1 shows an SEM image of the surface of YSZ film deposited on SDC20 pellet. As it shown in the image, YSZ crystal grew to large crystallite.

Fig.2 shows relationship between deposition time and thickness of YSZ film. Thickness of YSZ increased as increasing the deposition time. If the rate determine step of YSZ growth during electrochemical vapor deposition (EVD) is the electrochemical transport of charged species across the growing YSZ film, its growth rate should follow the parabolic law. [5] The deposition rate of Fig. 2 suggests the parabolic growth rate.

Relationship between gas flow rate and thickness of YSZ film is shown in Fig.3. The thickness was increased slightly when the gas flow rate was increased. The observation is interesting because the supply rate of metal chloride gases was independent of the gas flow rate. The reason why the thickness of YSZ film depends on Ar gas flow rate is now under investigation.

Thin YSZ films were fabricated on SDC20 pellet at considerably high rate. The YSZ film was transparent and tough against nail scratching.

References

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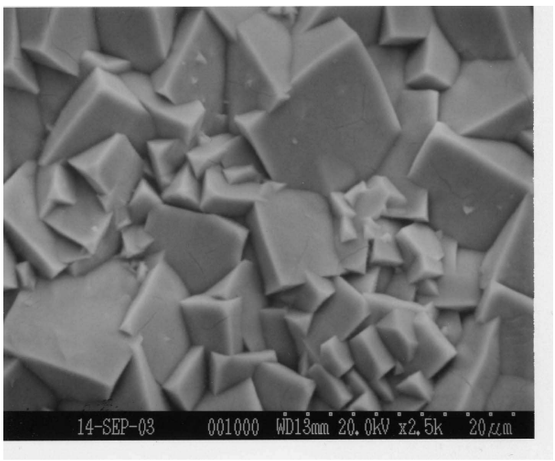

6.
Fig. 1 SEM image of the surface of YSZ film deposited on SDC20 pellet

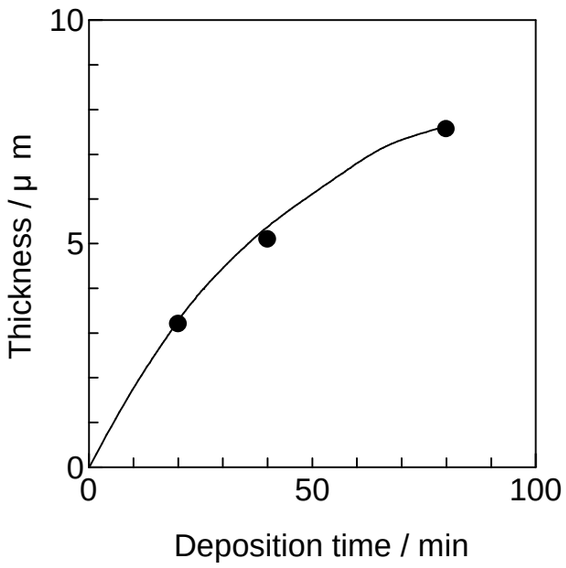

Fig.2 Dependence of YSZ film thickness on deposition time

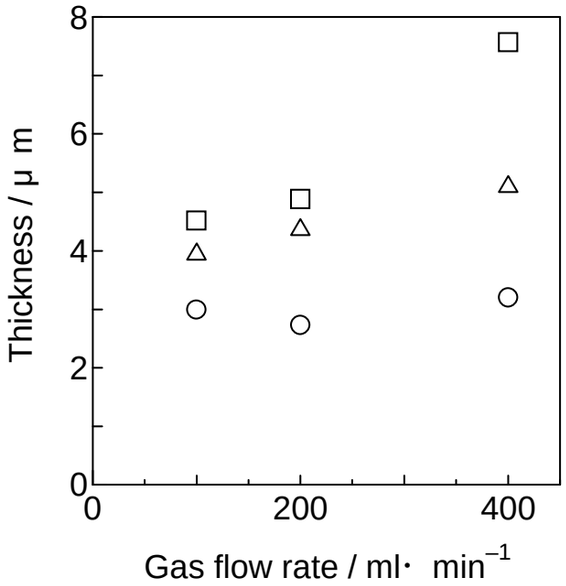

Fig.3 Dependence of YSZ film thickness on gas flow rate
Deposition time : ○ 20 min, △ 40 min, □ 80 min