論文 / 著書情報
Article / Book Information

題目(和文)	強磁場下における高配向B4Cセラミックスの作製とその特性
Title(English)	Fabrication of highly oriented B4C ceramics under strong magnetic field and their properties
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第11988号, 授与年月日:2021年3月26日, 学位の種別:課程博士, 審査員:吉田 克己,小原 徹,小林 能直,林﨑 規託,片渕 竜也
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第11988号, Conferred date:2021/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Thesis Outline

Title：Fabrication of highly oriented B_4C ceramics under strong magnetic field and their properties

Boron carbide (B_4C) pellets have been used as neutron-absorbers for fast reactors due to their high neutron absorbability, high melting point, thermal stability at high temperature, and low induced radioactivity after irradiation. However, the lifetime of B_4C pellets has been limited due to swelling effect and thermal stress leading to cracking and fragmentation of neutron-absorbers. High-performance B_4C pellets with excellent mechanical and thermal properties have been considerably required to extend their lifetime and enhance the safety of fast reactors. Generally, the properties of ceramics depend on the crystal orientation. Therefore, it is expected that their properties can be enhanced by achieving highly crystal orientation. In this study, highly oriented B_4C ceramics with/without alumina (Al_2O_3) as a sintering additive were prepared under a rotating strong magnetic field followed by spark plasma sintering, and their mechanical and thermal properties were evaluated. In addition, the effect of crystal orientation on the properties of B_4C ceramics was discussed.

Chapter 1: "Introduction" stated the background of B_4C selection in the nuclear applications, the current development of B_4C ceramics according to the previous studies, and the purpose of this study.

Chapter 2: "Fabrication of highly oriented B_4C ceramics by slip casting under rotating strong magnetic field" introduced manufacturing processes to obtain highly oriented ceramics using slip casting inside superconducting magnetic apparatus. The slip casting was performed under normal condition (random) and rotating strong magnetic field (high orientation), followed by densification by spark plasma sintering (SPS) and hot pressing (HP).

Chapter 3: "Effect of Al_2O_3 addition on the densification of highly oriented B_4C ceramics" explained the effect of Al_2O_3 sintering additive on the densification of highly oriented polycrystalline B_4C ceramics. Their density and porosity were measured by the Archimedes' method. Al_2O_3 addition to B_4C ceramics successfully enhanced their densification. The X-ray diffraction (XRD) and Rietveld analysis results found that aluminum borate (Al_5BO_9) was formed in B_4C with Al_2O_3 as secondary phase and assisted the densification of B_4C ceramics during sintering. The degree of orientation of highly oriented B_4C was evaluated by the calculation of the Lotgering factor (*f*).

Chapter 4: "Anisotropic mechanical properties of highly oriented B_4C ceramics with Al_2O_3 addition" provided the investigation of the effect of highly crystallographic orientation on the mechanical properties of B_4C ceramics with Al_2O_3 as a sintering additive compared to its random polycrystalline B_4C ceramics. Flexural strength was measured by three-point bending test apparatus. Hardness were measured by both Vickers hardness and nanoindentation.

Chapter 5: "Effect of highly crystal orientation on thermal properties of B_4C ceramics with Al_2O_3 addition" presented the evaluation of thermal properties of highly oriented and random B_4C ceramics with/without Al_2O_3. Specific heat values were measured using differential scanning calorimetry (DSC). Thermal diffusivity and conductivity were evaluated by LFA thermal analysis. Also, thermal expansion was measured by dilatometer.

Chapter 6: "Conclusion" stated the summary of each chapter and explained the achievement for the research objectives related to the fabrication of highly oriented B_4C ceramics under a strong magnetic field and properties. In addition, suggestions for future development were provided to improve neutron absorbers and other related nuclear applications.