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論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Synthesis and Microstructure Control in Cubic Boron Nitride Sintered Composite by the High Pressure and High Temperature Method
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学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

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（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	機械物理工学　専攻	申請学位（専攻分野）： Academic Degree Requested	博士　（　工学　） Doctor of
学籍番号： Student ID Number		指導教員（主）： Academic Advisor(main)	大竹尚登　教授
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This research was intended to control the cBN morphology and the grain size during synthesis process using the transition metal as the catalyst. Based on the assumption that the addition of Mo, Cr, V into the Fe, Ni, Co alloy is effective to increase nitrogen solubility in the solvent system, we described alloy solvent system as a combination of boron soluble elements, (Fe, Ni and Co), elements of increase nitrogen solubility, (Mo, Mn, Ta, Cr, Nb and V) and Al. Various (Fe, Ni, Co)-(Cr, Mo, V)-Al solvent composition to determine the cBN growth region along with its grain size and crystal was employed. The application of these metal solvents system as the sintering media in the cBN sintering process was also studied. The mechanical properties of the sintered polycrystalline cBN compact were measured and the cutting performance on the cast iron was evaluated.

Minimum pressures of cBN formation under (Fe, Ni)-Cr-Al, Co-(Cr, Mo)-Al and Co-V-Al solvents was confirmed at about 4.1 GPa. The minimum pressure of cBN formation was almost similar to that in the traditional alkali or alkali-earth B-N solvents.

The variation of alloy composition provides various morphology and grain size of cBN crystals. Boron and nitrogen solubility can be changed continuously by the variation of (Fe, Co, Ni)-(Cr, Mo, V)-Al system. Accordingly, crystal growth parameters such as solubility, diffusion constant of B and N in the alloy could be controlled. The results of the variety of cBN morphology employed the (Fe, Ni, Co)-(Cr, Mo, V)-Al solvent was presented. The crystal size and morphology of the cBN were different due to P-T condition and content of the solvents employed in the experiment.

The series of solvent system from Co-Mo-Al to Co-(Cr, Mo)-Al and Co-(Cr, V)-Al were reflected continuously increasing of nitrogen solubility in the alloys. The solubility of nitrogen into the Co-Mo-Al alloy was the smallest and it increase with increase of Cr content in Co-(Cr, Mo)-Al system and further increase of nitrogen solubility in the Co-(Cr, V)-Al was realized with increase the content of vanadium. The grain size of cBN was decreased with increasing nitrogen solubility of the alloy system and small agglomerate crystals were appeared in the Co-(Cr, V)-Al system.

These results indicated possible application of metallic solvent in the production of cBN abrasive grains. The morphology of cBN crystals is important information to the practice of cBN abrasives. The application of the alloy solvents with various combination of alloy composition could open the new field in cBN synthesis technology.

Secondly, as the metal solvent for cBN synthesis and the metal catalyst for cBN sintering are in general the same, it was showed that metal alloy solvent or catalysts which are able to suppress the cBN grain growth during cBN synthesis such as V is useful in producing the cBN compact with a homogenous microstructure during the infiltration sintering method.

High content polycrystalline cBN compact was also sintered with Co-V-Al metal catalyst. It was confirmed that as the nitrogen solubility in the metal catalyst increased by the addition of vanadium, the dissolution–precipitation process of the cBN grains in the molten metal catalyst during sintering process became more active. Hence, enhancing the cBN-cBN direct bonding and resulting the increasement of the hardness in PCBN compacts sintered compacts. The high content PCBN compact with the hardness as high as 39.9 GPa was achieved. Finally high volume content polycrystalline cBN cutting tools was made with Co-V-Al as the sintering media and their cutting performance was evaluated on the gray cast iron of FC300 and the ductile cast iron of FCD700 as a work material. It was showed that the PCBN sintered with Co-V-Al has the same degree of wear resistance comparing with tested commercial product. Co-V-Al could be used as a candidate of the sintering media for the high content PcBN cutting tool.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).