Returnee's Report

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Country, City	Germany, Darmstadt
Duration	10.4.2010 – 11.13.2010 (40 days)

Program Report

<Program Contents>

Research Topic: Synthesis and Evaluation of High-Temperature Behavior of Polymer-Derived SiOC-Based Ceramic Nanocomposites.

I learned synthesis and characterization methods for novel polymer-derived silicon oxycarbide (SiOC)-based materials. The characterization has been performed on the synthesized samples in terms of the "high-temperature-stability". Annealing of the polymer-derived SiOC ceramics at temperatures exceeding 1000 °C shows the phase separation of the single amorphous SiOC into amorphous SiO_2 and "free carbon." Subsequently, the amorphous silica reacts with carbon at higher temperatures (>1300°C) to form polycrystalline silicon carbide and gaseous CO. Incorporation of additional hetero elements into the amorphous Si-O-C system has been shown in some cases to improve the thermal stability and the crystallization resistance. Furthermore, high-temperature properties, namely oxidation and creep resistance, are expected to be improved by the incorporation of the additional hetero elements to the Si-O-C matrix.

In this research work, novel polymer-derived SiOC/BSAS (BSAS = barium strontium aluminum silicate) oxide ceramic nanocomposites have been synthesized and investigated with respect to thermal decomposition and crystallization behavior.

<Achievements/Ambitions>

The high temperature behavior of the prepared polymer-derived SiOC-based materials was studied with respect to phase evolution (detected by the X-ray diffraction (XRD)), microstructure development (observed by the scanning electron microscopy (SEM)), volume shrinkage, mass loss and elemental analysis. Annealing experiments at temperatures from 1300° to 1700°C have been performed. The 1300°C-annealed sample was found to be X-ray

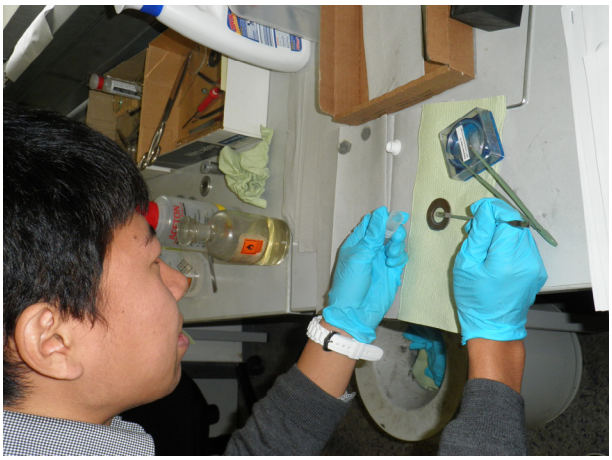
amorphous, which revealed that the incorporation of the additional hetero elements into the SiOC matrix investigated in this study remarkably increase the thermal stability of the amorphous SiOC matrix. Further study of the microstructure development, and chemical composition as well as the shrinkage and mass loss will be continuously investigated by Mr. Inata under the guidance of Dr. Emanuel Ionescu and his colleagues. The results obtained in this study exhibited the enormous potential of the polymer-derived SiOC-based nanocomposites for high-temperature application.

During my stay at TU-Darmstadt, I had a chance to learn novel ceramic materials of the unique ternary SiOC system which I have never learned before. All the experiences in this research work encouraged me to start further study of various ceramic-based materials. In addition, the experimental methods and techniques I learned in this study are found to be quite useful for developing phosphor materials which I am currently studying at Nagoya Institute of Technology, and I hope to improve the luminescent properties near future.

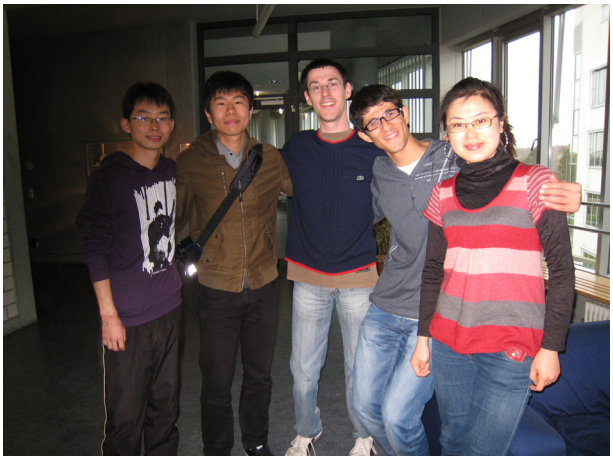
Finally, I would like to acknowledge to all the organizing members and support stuff of the ITP at Nagoya Institute of Technology for giving me such an excellent opportunity to stay at TU-Darmstadt, Germany.

I would like to express my sincere gratitude to Prof. Dr. Ralf Riedel and Dr. Emanuel Ionescu for their kind guidance, helpful discussions and advices throughout this research work at TU-Darmstadt, Germany.

1． The building with laboratory.



2． Experiment in the laboratory.



３．The photograph taken with indebted PhD students.