

List of Dissertation Abstract (Environment and System Sciences Materials System Course)

Name	Supervisor	Title	Abstract
Kotoko ICHIKAWA	Kenji ARAMAKI	Percolation behavior of a reverse micellar solution using nonionic surfactants	We observed percolation behavior of nonionic surfactant reverse micelles composed of Span20 and Tween80 in isopropyl myristate in presence of water and HCl. Abrupt increase of conductivity above 20°C is an indication of the typical percolation behavior, and the depercolation was observed at high temperature. The dynamic percolation behavior was suggested based on the scaling analysis of the conductivity change around the percolation temperature. Small-angle X-ray scattering data showed that reverse micelle microstructure transition with temperature was correlated with conductive behavior.
Naoki OKAMURA	Motoyuki IIJIMA	Influence of preparation condition of nonaqueous multicomponent slurries with polyethyleneimine (PEI)-fatty acid complex added on manufacturing process of Si <sub>3</sub> N <sub>4</sub> ceramics	Silicon nitride (Si <sub>3</sub> N <sub>4</sub> ) ceramics have excellent properties such as high strength and high toughness. Therefore, this material is applied as a structural material for bearings and engine parts. Currently, it is known from the past research that the dispersion and aggregation state of the aqueous slurries greatly influences the microstructure and microstructure of the sintered body. However, in the process of handling Si <sub>3</sub> N <sub>4</sub> powder, the use of nonaqueous solvent is required for preventing oxidation of powder. Therefore, the purpose of this research was to investigate the influence of preparation conditions of multicomponent nonaqueous slurries on the manufacturing process of Si <sub>3</sub> N <sub>4</sub> ceramics.
Miyuki OKAMURA	Kenji ARAMAKI	Study on hydrogel and organogel formed by sucrose fatty acid ester-glycerol fatty acid ester	We aimed to prepare hydrogel and organogel using food emulsifier. A highly hydrated $\alpha$ -gel can be prepared with monoglyceride and sucrose fatty acid ester, and an organogel can be prepared in the same system using squalane as a solvent. Since it is possible to prepare a gel with different viscoelasticity depending on the amount of sucrose fatty acid ester added, the possibility of preparing a hydrogel and an organogel suitable for a specific application was shown.
Takuma KITAI	Atushi SUZUKI	Contact charging properties of immiscible binary polymer blends and copolymers with various metals	The contact electrification becomes serious problem in taping system such as keeping and conveyance of electronic components. The Duke-Fabish model is used as a model to explain a contact electrification phenomenon when polymer contact with metal. As a result of confirming the electronic state distributions in polystyrene, an acceptor distribution suggested in the model was really confirmed. We confirmed change of the electronic state distributions by the composition of polymer blend and copolymer, investigated correspondence with surface structure, surface composition and relaxation characteristic.

Yuka Sueyasu	Mahito Atobe	Electrosynthesis of Porous Polypyrrole Materials Using Acoustically Prepared Foam Template	In this work, I reported an electrochemical polymerization in the acoustically prepared foam to obtain polypyrrole (PPy) film with microporous structure on an electrode surface. In this process, ultrasonication was used to foam the electrolyte solution containing a surfactant and the foamy electrolyte was employed as a soft template for the polymer growth. SEM analysis revealed that the obtained PPy film possessed a porous structure composed of a number of micropores. Since hard templates and cumbersome procedures are not required for this synthetic method, it is advantageous in respect of environmental and economic sustainability.
Ryota TAKEI	Kenji ARAMAKI	Preparation of nanoemulsion by PIC method using double-tailed polyglycerol-type surfactant	Nanoemulsions are attracting attention in the cosmetics and pharmaceutical industries because of their high stability and functionality. In this study, we prepared nanoemulsions by PIC method using lamellar liquid crystal ( $L_a$ ) which was formed by double-tailed polyglycerol-type surfactant (PGDL). By passing through lamellar liquid crystal during emulsification, nanoemulsions ranging from 30 to 200 nm were obtained. Moreover, they were stable for more than 50 days at room temperature. In addition, we found that surfactant-to-oil ratio was an important factor for preparation of nanoemulsion.
Ayaka TAJIMA	Mahito ATOBE	Fabrication of hollow polymer particles using acoustically formed fine bubble templates	The purpose of this study was to develop a new method of hollow particle synthesis that would contribute to green chemistry. In this work, we have developed a simple and novel method for the preparation of hollow nanocapsules covered with polypyrrole (PPy) or polyaniline (PANI) using fine bubble soft templates formed by ultrasonic irradiation. The key features of the method are an effective fine bubble generation by ultrasonication, size reduction of the bubbles by tandem acoustic irradiation, and its application for the template synthesis of nano-sized hollow particles.
Takaya TSUTSUMI	Motoyuki IJIMA	Effect of surface structure of silica nanoparticles surface modified under bead milling process on the property of composites with epoxy resins	Surface modification process to attach epoxy resin on $\text{SiO}_2$ nanoparticles through their reaction with polyethyleneimine (PEI) of PEI-oleic acid complex has successfully conducted with simultaneous bead milling treatment in toluene. The attachment of epoxy resin found to increase the $T_g$ of epoxy / $\text{SiO}_2$ composites and their storage modulus at temperatures higher than $T_g$ .

Yuya NAKAI	Kenji ARAMAKI	pH-responsive emulsions using amino acid-based gemini surfactant	We investigated pH responsive demulsification using the amino acid-based gemini surfactant, bis(N <sup>ε</sup> -lauroyl-L-lysine) sebacamide. Its aqueous phase behavior was changed from a transparent micellar solution, spinnability gel, turbid gel and solid deposition depending on pH. Emulsions prepared by using 0.1wt% surfactant solution (90wt%) and isopropyl myristate (10wt%) were successfully demulsified by adding 1M HCl aq. During this process, the solution pH was changed from 9.5 to 2.0, which could cause solid desorption of the surfactant molecules adsorbed at the oil-water interface.
Shun NAKAMURA	Atsushi SUZUKI	Network Structures and Mechanical Properties of Poly(vinyl alcohol) Gels Prepared by Freeze-Thawing Methods : Effects of Freezing Rate	Poly(vinyl alcohol) (PVA) hydrogels are hydrophilic, biocompatible materials. Physically crosslinked PVA gels prepared by a repeated freezing-thawing (FT gel) methods have been extensively studied for practical applications. In the FT gel, a macroscopic fibrous pattern is observed in the gel after gelation, which depends on the speed and direction of the freezing front during freezing of the PVA solution. In addition, it was found that there is a correlation between the speed of the freezing front and the physical properties such as swelling ratio and mechanical strength. We aimed to investigate the relationship between the microstructure and physical properties of the respective gel.
Saho FUJITA	Junichi TATAMI	Mesoscale Fracture Characteristics of Ceramics and Glasses Measured Using Microcantilever Beam Specimens	I adopted microcantilever method to evaluate the fracture characteristics near the surface of Si <sub>3</sub> N <sub>4</sub> ceramics soaked in molten Al, ion-exchanged glass, densified silica glass. The results revealed that this method can be applied to the evaluation of fracture characteristics of various materials and the evaluation of their strengthening and degradation.
Masatsugu MIZUNO	Mahito ATOBE	Electrochemical synthesis of poly(3-hexylthiophene) using a flow microreactor	Poly(3-hexylthiophene) (P3HT) has been used in many high-technological applications. However, their synthesis is usually required complicated multi-step processes and toxic transition metal catalysts. On the other hand, the integrated use of microflow technology for organic electrosynthesis would offer one of the most sophisticated processes in organic chemistry. In the present work, we have successfully developed the novel electrosynthetic system for the preparation of P3HT without its deposition using a flow microreactor. Molecular weight and its distribution of P3HT could be controlled by selecting the reaction conditions.

Seitaro MORITA	Motoyuki IIJIMA	Development of Particle Arrangement Control Methods in Nonaqueous Dense Multicomponent Slurries and Application toward Si <sub>3</sub> N <sub>4</sub> Ceramic Fabrication Process via Post-Reaction Sintering	Si <sub>3</sub> N <sub>4</sub> ceramics have excellent mechanical properties and thermal properties, which are promising materials as engineering ceramics. Having a strategy to form complicated shapes by wet processing and to reduce the cost by post-reaction sintering is important to expand Si <sub>3</sub> N <sub>4</sub> ceramic applications. However, the wet processing requires particle-arranged slurries to obtain suitable green bodies for post-reaction sintering. Herein we developed a process to control particle arrangement in the slurries based on the design of particle surface, and applied this process to the Si <sub>3</sub> N <sub>4</sub> manufacturing process via post-reaction sintering technique.
Yoshito YAMADA	Mahito ATOBE	Electrosynthesis of Conducting Polymer with Highly-Regulated Structure Using a Rotating Disk Electrode	A rotating disk electrode (RDE) which is often used for electrochemical analysis has been applied for electrochemical polymerization in order to control structure of the obtained polymer films. With this in mind, the electrochemical polymerization of aniline was carried out at RDE and properties of the obtained films were investigated systematically. As results, the polyaniline films with smooth surface could be obtained by the rotation of RDE. In addition, it was also found that the film density increased with an increase in a rotating speed.
Hirona YOSHIZAWA	Mahito ATOBE	Electrochemical generation of <i>o</i> -quinone in a flow microreactor and its application to various organic reaction	We have successfully demonstrated that a flow microreactor is extremely useful in controlling reactions involving an unstable <i>o</i> -quinone. This reaction system enables selective oxidation of catechol avoiding the oxidation of reaction partner, although the oxidation potential of reaction partner is close to that of catechol. The examination of several reaction conditions indicated that the key features of the method are an effective <i>o</i> -quinone generation and its rapid use for the following reaction without decomposition in a flow microreactor.
Takanoki WAKATA	Junichi TATAMI	Fabrication of coarse-equiaxed h-BN particle dispersed resin composite material and thermal conductivity	The composite material filled with thermal conductive filler as a heat dissipating material are used as the heat generation amount of electronic equipment increases. The thermal conductive filler is required to be a substance having coarse-spherical shape, high thermal conductivity and electric insulating property. In this study, we prepared a composite material of coarse-equiaxed hexagonal boron nitride (h-BN) particles prepared by NH <sub>3</sub> nitriding and resin, and clarified the influence on the formability and the thermal conductivity by this h-BN particle dispersion. As a result, it was improved that the formability and the thermal conductivity of the composite material.

Kenta WATANABE	Junichi TATAMI	Corrosion behavior of AlN ceramics by CF <sub>4</sub> /O <sub>2</sub> plasma.	I discussed the corrosion behavior of AlN ceramics corroded by CF <sub>4</sub> /O <sub>2</sub> plasma which is used in the plasma etching process of semiconductor making process. In the previous study, there are little data regarding the corrosion behavior of AlN ceramics considering AlN and secondary phase grains respectively. Therefore, corrosion behavior of AlN and secondary phase grains in AlN ceramics by CF <sub>4</sub> /O <sub>2</sub> plasma was evaluated. In this study, corrosion depth of these grains was measured quantitatively. Then, corrosion depth of AlN grains depends on oxygen impurities of AlN grains and that of secondary phase grains depends on the amount of fluorinated compound.
Sayuri WATANABE	Junichi TATAMI	Optical properties of yellow fluorescent Eu doped α-SiAlON	In white LEDs, phosphor particles dispersed in a resin. The resin is easy to be degraded by heating during operation to shorten lifetime of the white LEDs. Using transparent and fluorescent bulk ceramics instead of the particle / resin composite are one of the ideas to solve the problem. Eu doped α-SiAlON has been reported as a yellow phosphor and it has good thermal property. So it's suitable for application for white LEDs. But Eu doped α-SiAlON of bulk ceramics aren't fabricated and its optical properties aren't known. In this study, We fabricated Eu doped α-SiAlON and clarified relation between its optical properties and process factors.