Future collaboration

For my stay, Prof. Shuichi Yamamoto provided me a spacious room, right next to his office. Thus, we had quite a few chances to exchange research idea and discuss the differences of student's attitude toward study and school systems between two countries. We used to have this kind of talk at evening and sometime it was almost approach mid-night. After each talk, in the way back to my stay or even in my dream, some of the conversion popped up and kept me thinking. As stated previous, we are working the hydrophobic interaction of ion-exchange resin together and I am sure further comments and suggestions from Prof. Yamamoto in this aspect or other possible research projects should benefit my research group greatly.

Summary

I would like to express my deep appreciation toward Prof. Shuichi Yamamoto and his family for kind arrangement of my visit. Acknowledgement is also extended to Yamaguchi University, all the friends (Drs. Takashi Saekei and Kazuhiro Tanaka) and students. I also would like to thank Ms.Kaori Okada for her kind assistance to my living environment in Ube. I hope my visit was beneficial for Prof. Yamamoto and Yamaguchi University. I believed, in any aspect, this visit is the milestone for me to understand Japanese culture and society. I look forward to further correspondence.

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(3) Visit of Yamaguchi University, Department of Electrical and Electronic Engineering Ube City, August 14 - September 29, 2000

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世話教官：工学部・電気電子工学科教授　三好　正毅

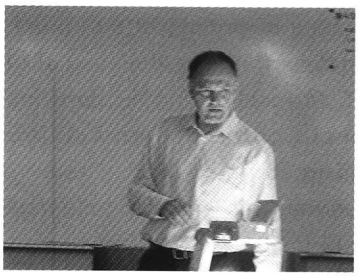
Introduction

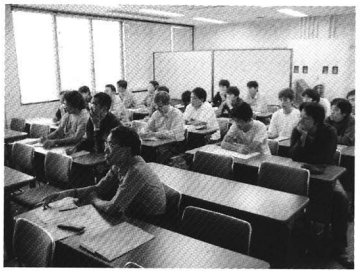
It is very nice to meet people from other parts of the world working on the same problems in the research. It is even better if some of the meetings turn out to be a beginning of the future collaboration. Fortunately, this was the case of my meeting with Prof. T. Miyoshi during his participation at the International Conference on Luminescence in Prague during summer 1996. There was a large overlap between his and my research interests. Prof. Miyoshi invited me in 1997 to visit his group at Yamaguchi University. I was very pleased that I was able to spend there nice five weeks which turned out to be very useful from both scientific and general points of view. Besides throughout scientific discussions, we performed joint experiments on photodarkening in semiconductor-doped glasses, the results were published in a joint paper [1]. A year later, Prof. T. Miyoshi visited my laboratory in Prague where we carried on the experimental work concentrated on the carrier dynamics in CdS doped glasses and we prepared another joint paper for publication [2]. I was very happy that I was able to come again to Yamaguchi university this year. I was appointed Assoc. Prof. of the University from August 14 to September 29, 2000. The main program of the visit was the experimental research of ultrafast carrier dynamics in semiconductor nanocrystals.

Research

My field of research is ultrafast optoelectronics. In particular, I concentrate on the II-VI semiconductor compounds as CdS, CdSe and CdSSe. These materials are considered to be very prospective in optoelectronics, e.g. for ultrafast all-optical switching. They are also very interesting from the viewpoint of basic research as systems in which charge carriers are confined in all three dimensions (quantum dots). The materials have typically optical nonlinearities with large magnitudes and fast response times.

There is a variety of preparation techniques of semiconductor nanocrystals. Recently, we have implemented preparation of CdSe, CdS nanocrystalline thin films by chemical bath deposition in Prague. We have used this technique for production of high quality thin films of CdSe and CdS nanocrystals with variable radii. The preparation of the sets of samples of nanocrystalline films with various nanocrystal sizes make it possible to study in detail the recombination and relaxation processes in the nanocrystals.





We studied recently the origin of photoluminescence in CdSe nanocrystalline films. On the basis of picosecond measurements of photoluminescence dynamics, we concluded that the recombination of the shallowly trapped carriers is the origin of the observed near-edge PL. We have found also that the red-shifted PL band is due to the recombination of a deeply trapped hole with an electron in an interior state or in a shallow trap. During this visit to Ube, we performed a series of experiments of ultrafast optical spectroscopy to study the carrier dynamics in both CdSe and CdS nanocrystals and we obtained results which are currently being prepared for publication. In particular, the measurements of spectrally resolved picosecond photoluminescence decay revealed the role of surface states in carrier dynamics in CdS nanocrystalline films on silica substrate and made it possible to interpret results of femtosecond absorption measurements obtained previously. We have studied, for the first time, the photoluminescence decay in nanocrystalline CdSe films grown on the crystalline silicon substrate and in two-layer CdSe films on crystalline silicon substrate with different nanocrystal sizes. The carrier recombination in nanocrystals was found to be affected substantially by the presence of silicon substrate. All the results obtained this summer in Ube indicate an application potential of multilyer CdSe nanocrystalline films in engineering (spectrum, relaxation times) the ultrafast optical nonlinearities.

Other aspects of the visit

I was really impressed by the quality of the scientific equipment in Venture Business Laboratory we could use for the experiments. In particular, the state-of-the-art femtosecond laser system (Spectra Physics) was used for ultrafast absorption and photoluminescence measurements.

I really enjoyed a nice collaboration with Dr. K. Yamanaka throughout my stay in Yamaguchi University. It is always great pleasure to discuss physics with Prof. T. Miyoshi, this time the most exciting and stimulating discussions for me were those on his results on thermoluminescence studies of photodarkening. It was very nice that I met again Assoc. Prof.N. Matsuo and Mr. N. Kawamoto from Prof. Miyoshi's group who kept helping me with the administrative and practical parts of my visit.

It was really great pleasure for me to give a lecture on my research to the Faculty members followed by an interesting discussion.

There is another point of view of my visit to Yamaguchi University which I enjoyed a lot during my both visits: wonderful Japanese countryside, amazing art and architecture, nice food, and most important very nice people.

Future collaboration

Ultrafast optoelectronics is no doubt a very rapidly developing field and it is of great importance to have a chance to cooperate in research with other laboratories with similar scientific topics. Prof. Miyoshi is one of the leading experts in physics of semiconductor nanocrystals in glasses. Moreover, the experimental facilities in Ube and in Prague are in greater part compatible. It would be therefore very useful to continue our mutual cooperation which will increase the effectivity of the research on both sides. It is very nice that Prof. T. Miyoshi plans to come to Prague during summer 2001 when we plan to continue our joint work. I hope we will be able to find ways of further collaboration in the future.

Conclusion

I would like to express my deep thanks to Prof. T. Miyoshi for inviting me and undertaking all the organization of my visit. I am grateful to the President of Yamaguchi University and the Dean of the Faculty for accepting me at the Faculty and the Venture Business Laboratory. I hope the joint collaboration will continue in the future.

[1] P. Maly and T. Miyoshi: Effect of photodarkening on photoluminescence dynamics in CdS-doped glass, J. Lumin. 90, 129 (2000)

[2] T. Miyoshi, N. Matsuo, P. Maly, F. Trojanek, P. Nemec, J. Kudrna: Negative and positive nonlinear absorption in CdS-doped glasses, J. Mater. Sci. Lett., in press (2001)

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(4) Visit of Yamaguchi University

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Introduction

I visited Yamaguchi University on kind invitation of Prof. Ikuo Awai, Department of Electrical and Electronic Engineering, in the frame of the Venture Business Laboratory with financial support of the Japanese Ministry of Education. This is my second visit to Yamaguchi University. The aim of the present visit was to join experiences concerning the development of new artificial materials for microwave application, both in theoretical studies and experiments, guidance for graduate students and academic staffs, delivering seminars on physical foundation and application of microwave complex media, consideration of the main aspects for possible continuation of scientific collaboration. This was a great chance for me, for the second time, to learn more about Japanese education, culture, and get a better understanding of Japanese thinking and approach to problems. I hope also that I was able to say something interesting about my country to many people I met.

Research

Development and implementation of new microwave components is a very important subject for many applications. To realize a new generation of microwave components one should focus his efforts in search for novel microwave materials. Artificial microwave materials are a very attractive subject in this search. Novel electromagnetic properties of artificial materials arise from particles ("atoms") with new properties that compose the material structure. New-effect artificial atoms appeared recently on the agenda in modern electromagnetics. Some time ago, I put forth an idea that small ferromagnetic (quasi-magnetostatic) resonators with special-form surface metallizations can be considered in microwaves as point particles with properties of local internal magnetoelectric (ME) coupling. Such artificial ME particles (that one can consider as glued pairs of small electric and magnetic dipoles) do not exist in nature. Theoretical analysis of composite materials based on these ME particles (bianisotropic materials) showed new (unknown for natural condensed media) electromagnetic properties. Experimental investigations carried out recently by the research group of Prof. I. Awai's laboratory in Yamaguchi University, have verified that quasistatic microwave ME effect really exists in small ferromagnetic resonators with special-form surface metallizations, as theoretically predicted. The artificial atoms are characterized by rich spectrums of ME oscillations that can be excited by external RF electric and magnetic fields. This is a new effect in microwaves. New microwave artificial materials (bianisotropic materials) can be synthesized as a structural composition of ferrite ME particles. A well-developed modern technology for thin-film ferromagnetic resonators can be successfully implemented for manufacturing new microwave devices.

During two years, since the time of my last visit to Yamaguchi University, our scientific collabora-