

FINAL REPORT
For Japan-Korea Joint Research Project

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| AREA | ① Mathematics & Physics 2. Chemistry & Material Science 3. Biology 4. Informatics & Mechatronics 5. Geo-Science & Space Science 6. Medical Science 7. Humanities & Social Sciences |
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1. Research Title:

Photo-induced ferromagnetism and coherent optical-manipulation in semiconductor nanostructures

2. Term of Research: From July 1, 2006 To June 30, 2008

3. Total Budget

a. Financial Support by JSPS: Total amount: 2,400 thousand yen

1st Year 900 thousand yen 2nd Year 1,200 thousand yen

3rd Year 300 thousand yen

b. Other Financial Support : Total amount: 250 thousand yen

4. Project Organization

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| a. Japanese Principal Researcher | |
| Name | Yasuaki MASUMOTO |
| Institution / Department | University of Tsukuba / Graduate School of Pure and Applied Sciences |
| Position | Professor |
| b. Korean Principal Researcher | |
| Name | Se-Young Jeong |
| Institution / Department | Pusan National University / School of Nanoscience and Technology |
| Position | Professor |

c. List of Japanese-side Participants (Except for Principal Researcher)

| Name | Institution/Department | Position |
|-------------------|---|-------------------------|
| Shinji Kuroda | University of Tsukuba / Graduate School of Pure and Applied Sciences | Associate Professor |
| Michio Ikezawa | University of Tsukuba / Graduate School of Pure and Applied Sciences | Lecturer |
| Shinichi Tomimoto | University of Tsukuba / Graduate School of Pure and Applied Sciences | Assistant Professor |
| Kazuki Bando | University of Tsukuba / Graduate School of Pure and Applied Sciences (Present: Shizuoka University / Faculty of Science) | Assistant Professor |
| Bipul Pal | University of Tsukuba / Graduate School of Pure and Applied Sciences | JSPS Foreign Researcher |
| Jeung-Woo Lee | University of Tsukuba / Graduate School of Pure and Applied Sciences | PostDoc |

d. List of Korean-side Participants (Except for Principal Researcher)

| Name | Institution/Department | Position |
|----------------|--|---------------------|
| Ho-Soon Yang | Pusan National University / School of Nanoscience and Technology | Associate Professor |
| Kwangseuk Kyhm | Pusan National University / School of Nanoscience and Technology | Associate Professor |
| Seong-Kyu Kim | Pusan National University / School of Nanoscience and Technology | Research associate |
| Hyeon-Jun Lee | Pusan National University / School of Nanoscience and Technology | Research associate |

5. Number of Exchanges during the Final Fiscal Year

a. from Japan to Korea

| Name | Home Institution | Duration | Host Institution |
|----------------------|------------------|-----------------------|------------------|
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| | | | |
| | | | |
| Total: _____ persons | | Total: _____ man-days | |

b. from Korea to Japan

| Name | Home Institution | Duration | Host Institution |
|------------------------------|---------------------------|-------------------------------|-----------------------|
| S. Jeong | Pusan National University | 2008/6/20-22 | University of Tsukuba |
| K. Khym | | | |
| H. Lee | | | |
| Total: _____ 3 _____ persons | | Total: _____ 9 _____ man-days | |

6. Objective of Research

Recently room temperature ferromagnetism in diluted magnetic semiconductors (DMS) is of great interest in application to spintronics, and electronic spins are known to play a crucial role in it. On the other hand, the development of ultrafast laser spectroscopy enables us to directly observe the dynamics of carriers in semiconductors and even control the quantum states as long as the coherence is maintained. Thus, as optical manipulation of the spin states utilizing the ultrafast laser is possible, the optical- spin control technology can be applied to both spintronics and quantum information processing. In this joint project between Japan (University of Tsukuba) and Korea (Pusan Nat'l University), photo-induced ferromagnetism in semiconductors such as Cr-/Co- dope ZnO and ZnTe will be explored by means of coherent optical-manipulation technology. Structures of fabricated samples will be preliminarily characterized by XRD, XPS, and EXAFS, and time-resolved Kerr rotation together with various coherent magneto-optic spectroscopy uncover the novel ferromagnetism in Co-doped ZnO:H and Cr-/Co-doped ZnTe. Finally, we will try to observe the photo-induced ferromagnetism nearby the critical point of the ferromagnetic transition, which will open up a new application to spintronics. Additionally, as strong confinement in quantum dots provides a long coherence time in electron spins, coherent electron spin dynamics will be investigated in MBE-grown and chemically-synthesized quantum dots such as InP, GaAs, (Cd, Mn)Te, and CdSe/ZnS by time-resolved luminescence/absorption, heterodyne-detected photon echo, and Hanle measurement. Optical nonlinearities and stimulated emission associated with exciton transition and biexcitons are also revealed in terms of carrier dynamics under strong optical excitation, which are of importance in the optical control of collective excitation and quantum dot light emitting devices.