(Form4-2)

JOINT RESEARCH PROJECT

FINAL REPORT
For Japan-Korea Joint Research Project

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

1. Research Title:

Nano-size-material optical fiber/waveguide devices self-assembled by light-matter interaction

2. Term of Research: From July 1, 2009 To June 30, 2011

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: 0 thousand yen

4. Project Organization

a. Japanese Principal Researcher	
Name	**Martinez Amos**
Institution / Department	**The University of Tokyo**
Position	**Research Associate**
b. Korean Principal Researcher	
Name	**Kyunghwan Oh**
Institution / Department	**Yonsei University**
Position	**Associate Professor**

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

Name	Institution/Department	Position
Shinji Yamashita	The University of Tokyo	Professor
Xu Bo	The University of Tokyo	Doctor's course student
Yuuya Takubo	The University of Tokyo	Master's course student
Kazuya Takahashi	The University of Tokyo	Master's course student
Kazumoto Fuse	The University of Tokyo	Master's course student
Chow Kin Kee	The University of Tokyo	Research Fellow

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

Name	Institution/Department	Position
Woosung Ha	Yonsei University	Graduate student
Yoon Seop Jeong	Yonsei University	Graduate student
Ji Young Park	Yonsei University	Graduate student

5. Number of Exchanges during the Final Fiscal Year*

*Japanese fiscal year begins April 1.

a. from Japan to Korea

Name	Home Institution	Duration	Host Institution
For Final Fiscal Year(FY2011) Total: 0 persons		For Final Fiscal Year(FY2011) Total: 0 man-days	
Numbers of Exchanges during the past fiscal years			
FY2009: Total 4 persons FY2010: Total 2 persons			

b. from Korea to Japan

Name	Home Institution	Duration	Host Institution
For Final Fiscal Year(FY2011) Total: 0 persons		For Final Fiscal Year(FY2011) Total: 0 man-days	
Numbers of Exchanges during the past fiscal years			
FY2009: Total 0 persons FY2010: Total 3 persons			

6. Objective of Research

Nano-size materials, such as CNT, have attracted attention in a number of applications. In the photonic applications, nano-size materials have been known to have versatile features, such as high nonlinearity and fast response time.

The Japanese principal researcher has pioneered the researches on photonic application of CNT into mode-locked fiber lasers and photonic switches. CNT offers several key advantages such as: an ultra-fast recovery time, small size, low background loss, polarization insensitivity. Using CNT, we have achieved a number of significant research results, such as realization of very stable mode-locked fiber lasers, including 1cm-long 10GHz mode-locked fiber laser, and demonstration of all-optical signal switching device for 10Gb/s signal. We are regarded as pioneers in this research, and have presented 18 invited talks and 3 postdeadline papers in international/domestic conferences, 4 invited papers in the technical journals. Initiated by our group, the research on photonic application of CNT has become a hot topic internationally, and a number of major research groups entered into it, including Cambridge Univ., Technical Univ. of Denmark, Tohoku Univ., Russian national research institute, and OFS.

The Korean principal researcher is the outstanding scholar in the field of optical fiber/waveguide devices, and is also known as the authority of self assembly of nano-size materials using light-matter interaction. He recently invented all fiber Bessel beam generator that could be used in optical trapping of nano/micro particles to initiate a new dimension of optically bound material including self assembled structures.

In this project, we plan to integrate the above studies of two groups. In the current fabrication method, nano-size material devices are normally made by applying (such as spraying) nano-size materials onto optical fibers/waveguides, which wastes most of expensive materials and thus is inefficient. By contrast, in the self-assembly method, the nano-size material layer is formed only in or around the optical path of the device, which can greatly enhance the usage efficiency of the material and reduce the cost. We plan to fabricate the nano-size material (CNT, etc.) devices, and apply them in telecom, sensing and nano-bio informatics. It will lead nano-size material photonic devices into the practical applications in these areas.

7. Methodology

In this project, we fabricated the nano-size material (CNT, etc.) devices, and applied them in telecom, sensing and nano-bio informatics. It will lead nano-size material photonic devices into the practical applications in these areas.

Year 2009
1. Fabrication of CNT fiber/waveguide photonic devices on the end faces
We will develop the optical deposition technique further to be able to form high-quality CNT layers at arbitrary thickness. We will optimize the fabrication conditions, such as CNT concentration and quality in the solution, injection optical power, light source wavelength, etc.
2. Fabrication of CNT fiber/waveguide photonic devices along the core region
We will try to make CNT devices in which CNT layers are formed along the core of fibers/waveguides through the evanescent wave coupling effect. We will prepare D-shaped fibers, tapered fibers/couplers, or cladless waveguides, inject light into them, and expect that CNTs are deposited along the core region.

Univ. of Tokyo will be mainly in charge of CNT preparation and CNT device fabrication, and Yonsei Univ. will be in charge of preparation of specialty fibers/couplers/waveguides. We plan to have two meetings, one in Tokyo and one in Seoul.

Year 2010
1. Fabrication of nano material fiber/waveguide photonic devices
We will apply the optical deposition technique to nano material in general, such as metal or semiconductor nano particles. We will also optimize the fabrication conditions, such as material concentration and quality in the solution, injection optical power, light source wavelength, etc.
2. Application of CNT fiber/waveguide photonic devices
We will further investigate the saturable absorption effect, and third-order nonlinearity in CNT device made by the optical deposition technique, and apply them to mode-locked fiber lasers and all-optical nonlinear devices, such as switches and wavelength converters. Transversally deposited devices are more attractive than the vertically deposited devices in terms of longer interaction length between CNT and light, thus higher nonlinearity and less optical damage are expected.

Univ. of Tokyo will be mainly in charge of nano material (including CNT) preparation and nano material (including CNT) device fabrication, and Yonsei Univ. will be in charge of preparation of specialty fibers/couplers/waveguides. We plan to have two meetings, one in Tokyo and one in Seoul.

Year 2011
1. Application of nano material fiber/waveguide photonic devices
We will try to apply the nano material photonic devices to optical fiber communications and sensings, for example, as the light source or nonlinear devices.

Yamashita will be mainly in charge of nano material (including CNT) preparation and nano material (including CNT) device fabrication, and Prof. Oh will be in charge of preparation of specialty fibers/couplers/waveguides.