

平成 28 年 4 月 10 日

国立研究開発法人理化学研究所  
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## 平成 27 年度実施 主任研究員の研究業績レビュー（中間）の結果について

主任研究員制度設置規程(平成 25 年規程第 13 号)第 5 条に基づき主任研究員の研究レビュー（中間）を踏まえ、レビューアーから送られた評価結果は以下のとおりです。

### 1. 評価対象：田原分子分光光学研究室 田原 太平 主任研究員

#### 1) 評価体制

実施日：平成27年 12月 2 日（水曜日）

4 名の所外有識者を評価委員とするヒアリングレビューを実施。

評価者：

Keisuke GODA, Professor

Graduate School of Science, University of Tokyo, Japan

Shin-ya KOSHIHARA, Professor

Graduate School of Science and Engineering

Tokyo Institute of Technology, Japan

Hiroshi MASUHARA, Chair Professor

National Chiao Tung University, Taiwan

Andrei TOKMAKOFF, Henry G. Gale Distinguished Service Professor

Department of Chemistry, University of Chicago, USA

#### 2) 評価結果の概要等

*General comments:*

【Reviewer 1】

**Research objectives:** This laboratory aims to develop the most advanced spectroscopy, apply it to the condensed phase, and try to explore new fundamental molecular phenomena. In the past term of 2008-2015, they have been studying time- resolved impulsive stimulated Raman spectroscopy, interface-selective nonlinear spectroscopy, and single molecule correlation spectroscopy, and so on. These spectroscopies are generally considered to be very important and indispensable to conduct the next stage research of molecular, biological, and material sciences.

**Research results:** This laboratory has published 61 papers for April 2008 - August 2015. They are mostly published in society journals like JACS, JPC, JCP, and so on, and two papers are for Science and Nature Communication. Compared to biological and life science fields, spectroscopy research is modest but very important. This publication status seems quite nice as a physical chemistry and spectroscopy laboratory. The fundamental progresses achieved here will contribute and support to develop science and technology in Japan.

**Management of the Laboratory:** Permanent staff of Drs. Takeuchi, Nihonyanagi, and Ishii constitute a nice spectroscopy team under the supervision of Dr. Tahara, and their facilities and equipment are excellent. This laboratory is indeed in the top level in this field. Dr. Tahara is contributing to Molecular Science Society in Japan and international conferences on vibrational spectroscopy and related topics. He is also a leader of KAKENHI: Innovative Area Project. His activity in molecular spectroscopy community is enough to attract many relevant scientists to RIKEN.

**Future research plans:** I believe that the future of molecular spectroscopy should be in “Exact Spectroscopy of Real System” covering chemical reaction, biological, and functional material systems. This will be one possible direction for physical chemist to compete with sciences of life, brain, space, information, and so on and to propose seminal concepts on understanding nature. I think that this laboratory will be one of the top groups in the world to demonstrate such research direction of molecular spectroscopy by utilizing Exact Spectroscopy in Real Systems. The necessary collaborations are easy in RIKEN.

**Overall assessment:** Excellent molecular spectroscopy laboratory which is indispensable in our country.

#### 【Reviewer 2】

Overall, Dr. Tahara is an excellent researcher, leader, and manager who continues to explore the field of molecular spectroscopy. His research interests build on his philosophy that if we can see what we could not see before, a new science will emerge. Specifically, he has developed time-resolved spectroscopy methods based on the pump-probe principle and applied them to various physical, chemical, and biological problems in order to provide solutions to them and gain a better understanding of the phenomena or effects behind them. This is supported by his excellent record of publications in top journals. I am particularly impressed by his efforts to uncover the previously-difficult-to-access physical mechanism of liquid interfaces (e.g., the water-air interface) with his newly developed spectroscopy method. His management ability and skills are also effective as it is evidenced by his team members’ success in both research and career development. Furthermore, his service to scientific communities such as Spectroscopical Society of Japan, Japan Society for Molecular Science, and Journal of Physical Chemistry is excellent and proves his continuing participation in promoting the interests of researchers in molecular science. I anticipate that his leadership in research combined with his efforts in interdisciplinary science will enrich RIKEN with a full of excitement.

#### 【Reviewer 3】

The Molecular Spectroscopy Laboratory at RIKEN, led by Dr. Tahei Tahara, develops new methods in ultrafast spectroscopy to study the molecular dynamics of condensed matter. Time-resolved spectroscopy is the most direct method to visualize chemical reactions and molecular behavior in solution. The Molecular Spectroscopy Laboratory’s

biggest impact over the past years has been the development of novel ultrafast vibrational spectroscopies to study chemical reaction dynamics and interfaces. The Laboratory is particularly well known for its design and use of sum-frequency techniques to reveal the femtosecond motions of molecules at aqueous interfaces. Similarly, its use of femtosecond stimulated Raman spectroscopy allows it to study the fastest motions of molecules, particularly during chemical reactions. In these areas of study, the Laboratory is among the very best worldwide. More recently, the development of new fluorescence correlation spectroscopy methods has resulted in a new capability of studying the conformational dynamics of proteins on microsecond time scales. These novel and exciting advances pave the way for a new generation of cutting edge spectroscopy and molecular dynamics studies.

The Laboratory is a well-managed operation. It consists of a diverse and international group with outstanding resources, ambitious plans, and considerable freedom to set their own research methods.

As a result, the Laboratory has highly motivated investigators that are very productive and publish high visibility, high impact research. Overall, the reputation for past work and the outlook for future research is world-class.

**[Reviewer 4]**

**Research objectives:** The objective items are well considered and keen based on the deep knowledges of optical science and laser technologies developed by their original way. The obtained results are surely playing a key role to expand the frontier of physical chemistry.

**Research results:** From the view point of “molecular spectroscopy for surface”, the experimental results have jumped up to a new stage comparing with the previous evaluation. Achieved results are, of course, excellent and highly evaluated from the wide view point of chemical and physical science. In addition, the expansion of their research into new filed of 2D-FLCS is quite challenging and will bring large impact on the field of life science. All results are highly evaluated as ‘world leading’ achievements.

**Management of the Laboratory:** Reviewer believes young members are surely enjoying scientific freedom under strong leadership of Dr.Tahara. This point has been well evidenced in the discussion with young members. Reviewer believes Dr.Tahara governs the Lab. quite well and efficiently for promoting a good basic science.

**Future research plans:** Reviewer feels it is quite important for this Lab. to demonstrate what can be ‘expected’ for molecular spectroscopic science beyond simple observation technique in both life (protein) and surface sciences. Until today, excellent and original results based on typical model systems have been achieved by Lab. members. However, for future, the challenge to systems which are important for other fields (such as channel proteins for the field of life science, catalyzing system on the water surface for synthetic chemistry etc.) will be essential for opening new field and demonstrating the importance of frontier research in spectroscopy for wide ‘audiences’. Reviewer believes that Lab. leader and members keep sufficient talent to open new channel for wide collaboration with another field researchers of chemistry, physics and life science inside and outside RIKEN.

**Overall assessment:** In the review process, reviewer has been strongly and deeply impressed with the evidence that basic research can emerge not only another basic research but also new applications under the collaboration with scientists and administrators. Reviewer highly evaluate the scientific achievements of “Molecular Spectroscopy Lab.” leded by Dr.Tahara. Reviewer also applauds the success of “RIKEN Scientific Administration” which has supported this Lab..

**Other opinions:** Of course, reviewer strongly believes Dr.Tahara has achieved a key contribution for constructing a new molecular science based on the concept of spectroscopy, and will open the door for new and original ultrafast light technologies to control the chemical reactions. In addition, reviewer believes that the next important and noble duty of Dr.Tahara and his Lab. members, as selected scientists for future of Japan, is “How to demonstrate the importance of their field to encourage the researchers of other fields and also RIKEN administrators”.

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