

Memorandum of Understanding

between

**The Regents of the University of California, as Management and Operating
Contractor for
Lawrence Berkeley National Laboratory**

and

**Korea Center for Artificial Photosynthesis, Sogang University, Republic of
Korea**

**Concerning Collaboration in the Fields of Materials Science and Chemistry
Associated with Artificial Photosynthesis**

This Memorandum of Understanding (MOU) is between The Regents of the University of California (The Regents), in its capacity as the manager and operator of the Lawrence Berkeley National Laboratory (LBNL), and the Korea Center for Artificial Photosynthesis, Sogang University, Republic of Korea (KCAP).

LBNL is a U.S. Department of Energy (DOE) National Laboratory managed and operated by The Regents pursuant to DOE Contract No. DE-AC02-05CH11231. KCAP is a government-funded scientific research center located on the Sogang University campus.

The Regents and KCAP are collectively herein referred to as the "Participants" or individually as a "Participant."

1. Objective

The Participants intend to explore potential future collaboration in the fields of materials science and chemistry associated with artificial photosynthesis.

2. Proposed Areas of Collaboration

The Participants intend to collaborate in one or more of the following areas:

- Evaluation of candidate membrane materials for use in solar CO₂ reduction systems. Desirable properties include durability, good ionic conductivity, resistance to plasticization by CO₂, and impermeability to CO₂ reduction products.
- Strategies to provide higher concentrations of CO₂ at the electrode surface, given that CO₂ has very low solubility in electrolytes, with reduction reaction efficiency often limited by transport rates through the liquid in contact with the electrode.
- Multiphysics modeling and construction of devices for CO₂ reduction into liquid fuels, including exploration of new photovoltaic-electrolysis architectures.

July 20, 2016

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- Prospective lifecycle assessments and technoeconomic analyses of solar CO₂ reduction systems to evaluate sustainability and cost structures of technology options arising from the research.
- Stable thin film materials for CO₂ reduction devices including corrosion protection, insulators and semiconductors.
- X-ray science techniques for in situ and operando studies of CO₂ reduction catalysis, including design of electrochemical cells.

The scope of the above activities and cooperation may be changed or extended to other areas by mutual written consent of the Participants.

3. Proposed Forms of Collaboration

The Participants expect to collaborate through mutual visits, the exchange of publicly-available information, exchanges of researchers and experts, training and planning for potential future joint research, with any future collaborative research to be undertaken only pursuant to an appropriate written agreement therefor.

4. Proposed Mechanisms of Collaboration

- a. To administer the implementation of this MOU, each Participant should designate one or more principal coordinators to be in charge of the collaboration, through whom all requests and plans of that Participant should be made.
- b. The principal coordinators may hold meetings when necessary to discuss matters related to collaboration under this MOU.
- c. The principal coordinator for The Regents is Dr. Frances Houle, or, in the alternative, Dr. Ali Belkacem. The principal coordinator for KCAP is Professor Kyung Byung Yoon, or, in the alternative, Professor Young Soo Kang.

5. Commencement, Modification and Discontinuation

- a. Cooperative activities under this MOU may commence upon signature of the Participants and continue for a 5 year period, unless discontinued in accordance with paragraph b. of this Section.
- b. The Participants may discontinue this MOU at any time by mutual written consent. Alternatively, a Participant that wishes to discontinue its participation in this MOU should endeavor to provide at least thirty (30) days written notice to the other Participant.
- c. This MOU may be modified or extended for additional periods by mutual written consent of the Participants.

6. Exchange of Information

The Participants do not anticipate the exchange of business-confidential information or the creation of intellectual property. If the Participants decide that a particular activity may lead to the exchange of business-confidential information or the

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creation of intellectual property, they should consult with each other and enter into an appropriate written agreement therefor.

7. General Provisions

- a. This MOU does not create any legally binding obligations between the Participants.
- b. Each Participant should conduct the activities contemplated by this MOU in accordance with all applicable laws, regulations and other requirements to which it is subject, including, without limitation: export control laws; environmental, health and safety laws and regulations; and international agreements to which its Government is party.
- c. The conduct of cooperative activities contemplated by this MOU is subject to the availability of funding, personnel, and other resources.
- d. Each Participant is to be responsible for the costs it incurs in participating in cooperative activities under this MOU.

Signed in duplicate:

FOR THE REGENTS OF THE
UNIVERSITY OF CALIFORNIA:

By:

Michael Witherell

Name: Michael Witherell

Director, Lawrence Berkeley

Title: National Laboratory

Date:

7/23/2016

Place:

Berkeley, CA USA

FOR KOREA CENTER FOR
ARTIFICIAL PHOTOSYNTHESIS,
SOGANG UNIVERSITY:

By:

Ki-Pung Yoo

Name: Ki-Pung Yoo

Title: President, Sogang University

Date:

8/17/2016

Place:

Seoul, Korea