MOU Number: MOU-18-497

MEMORANDUM OF UNDERSTANDING

Between

The National Renewable Energy Laboratory
Represented by the Alliance for Sustainable Energy LLC under contract to
the United States Department of Energy

15013 Denver West Parkway
Golden, Colorado 80401
United States of America

And

Forschungszentrum Jülich GmbH
represented by its Board of Directors

for: Institute of Energy and Climate Research
Electrochemical Process Engineering (IEK-3)
and
Institute of Energy and Climate Research
IEK-5 Photovoltaics
52428 Jülich
GERMANY

For Coordination of activities in the field of Advanced Energy Technologies

INTRODUCTION

The National Renewable Energy Laboratory (NREL), a national laboratory managed and operated by the Alliance for Sustainable Energy, LLC for the United States Department of Energy (DOE) under Contract No. DE-AC36-08GO28308.

Forschungszentrum Jülich GmbH (JUELICH), located in Jülich, Germany, is one of the largest interdisciplinary research centers in Europe and a member of the Helmholtz Association of German Research Centers. It is mainly funded by the Federal Ministry of Education and Research (BMBF), and other federal and state ministries in the implementation of program-related funding.

As part of its mission for DOE, NREL conducts research and development on a wide scope of renewable energy and energy efficiency technologies and applications, including solar energy and hydrogen research.

At JUELICH, the development of renewable energy technologies is pursued for future sustainable energy systems. It conducts research on both the development of technologies for efficient and economic silicon and perovskite based photovoltaics, as well as the investigation of the fundamental physics of these solar cell technologies. Furthermore, JUELICH develops electrochemical technologies such as electrolysis and fuel cells. Here its focus lies on the

development of materials, components, and characterization methods for electrochemical technologies and applications.

NREL or JUELICH is each individually referred to as a "Participant" and collectively as "Participants."

The purpose of this MOU is to encourage coordination in areas of mutual interest and benefit to both Participants. Based on the principles of equality and reciprocity, this MOU is intended to serve as a general framework for planned coordination between the two Participants and is intended to facilitate discussions for the development of a more specific planned program of research and development (R&D) collaboration. Any specific program of collaboration or sharing of confidential information is to be implemented through an appropriate written contract between the Participants.

Section 1: Areas of Coordination and Collaboration

The coordination activities planned under, and the programs of collaboration contemplated in furtherance of, this MOU are focused on cooperation to maximize the benefit of each Participant's respective institutional interests, which may include the following selected topics:

Solar Energy

1. Increased understanding of performance and Reliability
   - Outdoor characterization of PV modules with fast imaging based methods
   - Defect/ failure analysis from module to cell level
   - Defect modeling and loss analysis on module level
   - Investigation of module stability under light exposure, high temperatures, high electrical potentials, and multi-stress testing
   - Development of degradation models for PV modules (e.g. CIGS, SHJ, high lifetime Si devices)
   - Preconditioning analysis (influence of temperature, irradiation, electrical bias) for CIGS and CdTe
   - Performance data analysis

2. Increased understanding of novel Concepts and Materials
   - Silicon thin film alloys (e.g. as passivation layers for silicon wafers)
   - Computational materials research

3. Increased understanding of photocatalytical Solar Fuel Generation
   - Characterization of solar cell devices for water splitting
   - Development of hydrogen and oxygen evolution catalysts using non-precious metals

Hydrogen

1. Increased understanding of characterization of materials and components for electrochemical technologies and applications (e.g. electrolysis, fuel cells)
   - Development of electrochemical characterization methods and techniques
   - standardization/Harmonization Activities
   - system analysis for the transition to Renewable Energy Systems

Section 2: Forms of Coordination

Planned coordination under this MOU may include:

1. Exchange of published scientific and technical information, publications, and reports;

2. Meetings organized to discuss specific topics identified in Section 1, including conferences, seminars, and workshops;

3. Exchange of scientists, engineers, and other specialists for participation in workshops, conferences, seminars, working sessions, and model-development activities. Each Participant should abide by the health, safety, and environmental requirements of the host Participant when on an exchange assignment at the host Participant's facility.

Section 3: Funding

1. The scope of coordination activities under this MOU should be mutually determined in light of time, resources and/or funds available at both institutions for the types of coordination undertaken and by such other financial assistance as may be obtained by either Participant from external sources.

2. Unless the Participants otherwise determine in a separate written agreement, each Participant is to be responsible for the costs it incurs in participating in the coordination contemplated by this MOU, including all administrative costs, overhead expenses, labor costs, insurance costs, travel expenses and similar costs.

Section 4: Researcher Exchanges

1. Each Participant retains responsibility for its own personnel in relation to researcher exchanges to carry out coordination under this MOU.

2. Each Participant's personnel should abide by the regulations, policies, and procedures of the host Participant in carrying out activities under this MOU, including protection of business proprietary information, protection of intellectual property, compliance with their respective export control laws and regulations, conditions of coordination and decorum, health, safety, and security requirements, and all other terms under which personnel are authorized to participate in researcher exchanges at the host Participant's facility. Such activities may require entry into separate written agreements.

3. Each Participant is to be solely responsible for its own personnel in relation to matters such as visa and travel formalities, appropriate insurance (medical insurance and medical evacuation and repatriation insurance), travel expenses, and suitable living accommodation and expenses.

4. To the extent possible, the host Participant should assist in facilitating travel arrangements of the other Participant's personnel in relation to researcher exchanges in accordance with its applicable procedures governing foreign national access to the host Participant's facility.

Section 5: Dissemination of Information

Each Participant intends to participate in the coordination in a manner that facilitates exchanges of publicly available, non-proprietary business information. Subject to applicable laws and regulations of its country, each Participant may disseminate information, data, and reports of the coordination carried out under this MOU.

Section 6: Use of Information

Any information transmitted by one Participant to the other Participant under this MOU should be accurate to the best knowledge and belief of the transmitting Participant.

Section 7: Intellectual Property

The Participants do not anticipate the transfer of rights in intellectual property or the sharing of confidential information to occur under any planned coordination activity under this MOU. If it appears that a particular activity may lead to the creation of intellectual property or the disclosure or exchange of confidential information, the Participants should enter into an appropriate written agreement therefore.

Section 8: Future Collaborations

Any specific future research and development collaboration, including the exchange of intellectual property or confidential information, or the transfer or commitment of funds is to be implemented through an appropriate written contract between the Participants. Any such contract should include a work plan, staffing requirements, cost estimates, funding sources, the adequate and effective protection and allocation of intellectual property rights, and other arrangements or conditions; and must be authorized under NREL's Management and Operating Contract.

Section 9: Review of Coordination

The Participants intend to review the coordination undertaken under this MOU as a means to ascertain its effectiveness, document achievements and lessons learned, recognize technical personnel, and identify and plan areas for potential future collaboration that involves the conduct of research and development. This review should take the form of periodic meetings of representatives of each Participant to discuss ongoing coordination and to identify and plan future collaboration that involves the conduct of research and development activities.

Section 10: Contacts

One or more designated representatives from each Participant should oversee, manage and facilitate implementation of this MOU in cooperation with each other on behalf of their respective institutions. All notices, communications and coordination should involve, at a minimum, the following individuals, their successors and/or designees as follows:

(a) For the National Renewable Energy Laboratory:

Scientific contact person:
Peter Hacke
15013 Denver West Parkway
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Contracts contact person:
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(b) For the Forschungszentrum Jülich GmbH:

Scientific contact person:
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Contracts contact person:
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Tel: +49 2461 61-8868
a.de.guia@fz-juelich.de

Section 11: General Considerations

1. This MOU is not intended to create any legally binding obligations between the Participants.

2. Each Participant should conduct the coordination contemplated by this MOU in accordance with applicable laws and regulations to which it is subject and international agreements to which its government is party.

Section 12: Commencement, Modification and Discontinuation

1. Coordination under this MOU may commence upon signature, and may continue for a period of five (5) years, unless discontinued in accordance with paragraph 3 of this section.

2. The Participants may modify this MOU at any time by mutual consent in writing.

3. The Participants may discontinue coordination under this MOU at any time by mutual consent in writing. Alternatively, a Participant that desires to discontinue its participation in this MOU should endeavor to provide the other Participant at least 90 days advance written notice.

Signed in duplicate.

For
National Renewable Energy Laboratory

W.T. Farris

William T. Farris
Associate Laboratory Director
Innovation Partnering & Outreach

2/21/2019
Date

Golden CO USA
Place

For
Forschungszentrum Jülich GmbH

H. Bolt i.V.

Prof. Dr. Harald Bolt
Member of the
Board of Directors

i.V. Prof. Dr. Detlef Stolten
Institute of Energy and
Climate Research
Electrochemical Process
Engineering (IEK-3)

i.V.

Date

i.V.Prof.Dr.Uwe Ra
Institute of Energ
and Climate Resear
-Photovoltaics
(IEK-5)

Jülich