

EP/R034540/1: Defect Functionalized Sustainable Energy Materials: From Design to Devices Application

Description of project

The aim of this project was to establish a world-class research and networking hub that can accelerate the creation of innovative materials for energy applications. The Sustainable Advanced Energy Materials (SAEM) hub is focused on developing energy materials, such as electronic materials for low power consumption, high-efficiency photovoltaic materials, high-efficiency power-saving catalytic materials, and the elimination of the use of toxic/rare elements as much as possible. The main themes include: (1) material design and synthesis, (2) defect modeling, characterization and function of defects, (3) novel semiconductors, (4) chemical reaction and catalytic functions, and (5) new functional materials for energy generation. The initial goal of the hub was to establish an international research exchange system early in the implementation period via setting up a number of joint research projects within the specific research themes that could be sustained after the implementation period. This required the involvement of early carrier researchers and establishing a collaboration environment where young researchers could promote new ideas, present research results, and exchange ideas with their peers during the exchange activities and beyond.

Departments and institutions involved

The three main applicants were: the Tokyo Institute of Technology Element Strategy Center, UCL and McGill University, Canada. TokyoTech was in charge of the electronic materials area of the Japan's Ministry of Education, Culture, Sports, Science and Technology Element Strategy Project from 2012 to 2021. The Element Strategy Center also included the representatives from the Research Center for Functional Materials at NIMS and the Institute of Materials Structure Science at KEK, as well as several academics from the University of Tokyo, University of Tsukuba, Kyushu University and Nagoya University, who took active part in this project. At UCL, there was active involvement from members of departments of Physics, Chemistry, Electrical and Electronic Engineering, and Chemical Engineering. Several members from the Physics Department at KCL and the Department of Materials at Imperial College were involved in several projects. At McGill University, members of Physics, Chemistry and Materials departments were actively involved. The total number of academics involved in the project was 22 from Japan, 23 from UK and 8 from Canada.

How collaboration started

The collaboration derived from the previous connections and collaboration between the groups of Profs. A. Shluger (UCL), H. Hosono (TokyoTech) and P. Grutter (McGill).

Amount of money awarded: £470,810.80

How the matching funds were sourced from your side and how it was used

Matching funds have been provided by UCL to support and facilitate visits by the members of McGill team to project symposia and collaboration at UCL.

How participants benefitted from the scheme

More than 60% of resources were allocated on travel, subsistence, networking and collaboration building activities. The participants benefitted from establishing collaborations, which have resulted in more than 10 publications in international journals to date. A project funded by InnovateUK “Scanning probe fabrication and readout of atomically precise silicon quantum technologies” has been funded including the UCL members (Prof. N. Curson and Dr. T. Stokes), McGill University (Prof. P. Grutter) and SME Nanolayers Research Computing Ltd. as a result of this collaboration. Early career researchers from Japan, Canada and the UK acquired research skills through theoretical and experimental training in collaboration with their counterparts.

The collaborative developments since the project started and plans for future

To initiate and sustain the exchange and collaboration activities, 9 project symposia were held cyclically in Japan, UK, and Canada. In the initial symposia, 20-30 of the participating researchers presented their research (open to the public), and in group discussions (closed to the public). Each working group identified problems and developed joint research strategies to solve them. From the mid-term onwards, the progress and results of these joint research projects were discussed at project symposia, and further joint research was derived. In particular, the 7th symposium was divided into two sessions and was fully open to the public as symposia D-3 and D-5 of the Materials Research Meeting (MRM) 2021 (hybrid), the largest international conference on materials held in Japan, and widely promoted the research results of this project. The last project symposium was held in London on December 12-13, 2022. The project funds have been used in the first two years of the grant to successfully establish and support 15 collaborative projects between research groups at UCL with counterparts in Japan (TokyoTech, NIMS, KEK), and McGill University. Most of the T&S funds have been spent on travel of academics, PDRAs and PhD students to project meetings in Montreal and Tokyo as well as organising project meetings and 4 successful project symposia in London.

Seven long-term visits by UCL PDRAs and PhD students have been made to McGill University and five to TokyoTech. Many young researchers, including postdoctoral researchers and graduate students, participated in the project symposia described above, and gave oral and poster presentations, forming a network of young researchers among the collaborating centers. A summer school was held at McGill University in parallel to the project symposium in April, 2019. The school was organised by PhD students and hosted by eight laboratories at McGill University attended by 10 PhD students from UK and Japan.

Due to travel and work restrictions imposed during COVID19, all travel to Japan and Canada has been suspended from March 2020 and the collaborative research work continued at participating institutions. The already established 15 projects required further face-to-face interactions and researcher exchanges to bring them to fruition. To build upon the momentum that was generated within the programme and continue the collaboration and visits after the travel restrictions were lifted in 2022, the project has been extended till 31 October, 2023.

Further applications to JSPS for funding or plans for this: Further applications will be made by members of particular projects to continue their activity.

Figure 1: Project symposia in Montreal, London and Tokyo



Figure 2: Participants of the Summer School at McGill University in 2019

