2017 Helmholtz – OCPC – Programme
for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project: Colloidal route-based nanostructure synthesis for energy storage applications

Helmholtz Centre and institute: Helmholtz-Zentrum Berlin für Materialien und Energie, Institute of Soft Matter and Functional Materials

Project leader: Dr. Yan Lu

Web-address: http://www.helmholtz-berlin.de/forschung/oe/em/soft-matter/index_en.html

Description of the project (max. 1 page)**:**

Design and synthesis of various novel nanostructures has emerged as a rapidly expanding topic, which have been widely applied in electrochemical energy storage, catalysis, thermo-electrics and solar fuels. Using colloidal routes, which are bottom-up, low-cost, simple, and scalable in comparison to other synthesis methods, such nanostructures can be prepared with precise control of the morphology. The present project will, thus, focus on the synthesis and characterization of novel porous carbon or metal oxide nanomaterials using colloidal routes, which can be applied as electrode materials for energy storage applications.

For this purpose, various carbon or metal oxide (such as TiO_x, SnO_2, etc.) nanomaterials with hierarchical porous structures will be designed and synthesized. Here due to the high surface area of 2D materials, special emphasis will be paid on 2D carbon or metal oxide (such as TiO_x, SnO_2, etc.) porous nanostructures, which could offer a unique opportunity to surpass the current limitations on energy density of electrode materials for energy storage. By precise control of the pore size and morphology of the materials, we are aiming to understand the impact of the structures on the electrochemical properties. In addition, the surface properties of the materials will be further modified to a certain extent by either doping or introducing a functional group in order to improve the electrochemical performance of the nanomaterials.

Moreover, binder materials play an important role on the electrochemical performance. As one of the most commonly used binders, PVDF has shown some drawbacks, for instance limited surface activity for binding all electrode components eventually, and reduction of pore volume of the active materials. In this project, poly(ionic liquid) (PIL)-based polymers, as a new generation of binder materials, will be employed in parallel to PVDF as binder to reach the optimal performance. The role of PIL-based binders on their electrochemical performance will be studied in detail as well.

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

The project leader already has an established close collaboration with the research group of Prof. Guosong Chen and Prof. Ming Jiang from Department of Macromolecular Science, Fudan University, which is a world-leading group on self-assembly of functional macromolecules. We have successfully applied a joint Sino-German Research Project together running from 2015 to 2017 on exploring the mechanism of morphological transitions of macromolecular self-assemblies. In the last three years, we have published 3 papers together including one in the journal of *J. Am. Chem. Soc.*. The group of Prof. Chen and Jiang has strong expertise on synthesis of macromolecules with controlled assembles and functionalities, with emphasis on understanding the fundamental issues of structural assembly and growth that will enable the rational control of the material morphology, micro/nano-structure, and property. We would like to continue our collaboration by sharing our research interest on the synthesis and characterization of new hybrid materials based on inorganic/organic functional nanostructures for energy storage.

Required qualification of the post-doc:

- PhD in Chemistry or Material Chemistry
- Experience with wet-chemistry synthesis techniques, and characterization of carbon or metal oxide nanostructures
- Additional skills in electrochemistry characterization methods

PART B

Documents to be provided by the post-doc:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team