Postdoctoral position on the discrimination and trapping of battery parasitic species using solid-state nanopores

CY Cergy Paris University (Dr. Benjamin Cressiot) and **Collège de France** (Pr. Jean-Marie Tarascon) are looking for a **postdoctoral research associate** to work at the interface of nanotechnology and electrochemistry on the **detection and trapping of battery parasitic species in Li-ion batteries**. The postdoc will mainly work at Collège de France (Paris) in a stimulating environment. **The project is funded by the DIM Respore for 12 months and can be reconducted.**

Context: Batteries play a central role in the ongoing transition from fossil fuels to renewable energy. One of the challenges is to monitor inside the cell battery the electrolyte stability, responsible of capacity stability, during charge and discharge cycles. This capacity loss is due to polysulfide solubility (S_8^{2-}, S_6^{2-}, etc…) in the electrolyte. These chemical species result from reduction of Sulphur by lithium. This step is necessary to get the fully reduced and insoluble Li_2S. Polysulfide can then diffuse to the Li° electrode, be reduced there and passivate the surface of the negative electrode. Longest polysulfide chains can be only partially reduced on the Li° surface and diffuse back to the positive electrode where it can be oxidized again. The Pelta's group (LAMBE laboratory) and Tarascon's group (Collège de France) recently showed (accepted in Nat. Comm. Mat.) the ability of a protein nanopore to sequence Na_2S_x ($3 \leq n \leq 5$) in aqueous media using cyclodextrins (CDs) adapters having high affinities for polysulfide species. A multidisciplinary approach combining spectroscopic and electrophysiological experiments was adopted to understand at the molecular level the host-guest complexation equilibrium between the CDs and polysulfides. We used this strategy to enable single molecule nanopore detection, and demonstrated this technique as being a powerful tool to discriminate in aqueous medium different polysulfides with a single sulfur atom resolution, hence specifically sequencing species migrating through a membrane.

Position summary: the candidate will manufacture solid-state nanopores with small diameters for the detection of polysulfides. The project will explore the detection and characterization of these polysulfide species in battery conditions (organic solvent, effect of temperature and cycling conditions).

Job requirements: The candidate must have a Ph.D. in biophysics, or a Ph.D. in a related field and relevant experience. The candidate must have experience with electrical detection experiments and solid-state nanopores. Experience with transmission electronic microscopy (TEM) and programming for experiment automation and data analysis (Igor, MATLAB, Labview, Python) is a strong plus. The candidate must have good oral and writing skills.

Bibliography:

- Grey, C. P. & Tarascon, J. M. Sustainability and in situ monitoring in battery development. ***Nature Materials*** 16, 45–56 (2016). (https://doi.org/10.1038/nmat4777)
- Larcher, D. & Tarascon, J. M. Towards greener and more sustainable batteries for electrical energy storage. ***Nature Chemistry*** 7, 19–29 (2015). (https://doi.org/10.1038/nchem.2085)
- Cressiot, B., Greive, S. J., Mojtabavi, M., Antson, A. A. & Wanunu, M. Thermostable virus portal proteins as reprogrammable adapters for solid-state nanopore sensors. ***Nature Communications*** 9, 4652 (2018). (https://doi.org/10.1038/s41467-018-07116-x)
- Betermier F. and Cressiot B., Di Muccio G., Jarroux N., Bacri L., Morozzo della Rocca M., Chinappi M., Pelta J. and J.M. Tarascon. ***Nature Communication Materials***, 2020, accepted.

Applicants are invited to submit an email including cover letter, a summary of previous research, CV with publication list, and 2 or more reference letters, to:

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