PhD Topic at LRCS, Amiens, FRANCE https://www.lrcs.u-picardie.fr/	
Topic Title	*Stabilization of Li and Na metal surface anodes for different battery technologies*
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Co-advisor	NA
Collaborations	NA
Funding Source, Name of project	RS2E – French Research Network on Electrochemical Energy Storage
Web Site of Advisor (if applicable)	
Date of publication of the offer	May 4, 2017
Deadline for application	June 30, 2017
Date of start of the Project	October 1st, 2017
Description of the Topic	Further to the significant progress realized in the development of positive electrodes materials and electrolytes for Lithium - sulfur (Li-S) and Lithium-air (Li-air) batteries, the stability of metallic lithium as negative electrode stays a challenge to solve for the development of these systems. As many metallic electrodes, the lithium is morphologically dynamic, its surface evolves during the electrochemical aging. Indeed, a part of the lithium is dissolved and then redeposited on its surface in a heterogeneous way leading to the growth of a porous moss with a change of volume, and sometimes to the formation of dendrites at high speed of cycling. The modification of the reactivity of lithium metallic surface by coating functional barriers is a good strategy to improve the performances of electrochemical devices using metallic lithium, with an improvement in capacity and aging, especially for strong current densities. The layer coating must be dense to avoid the direct contact between metallic electrode and liquid electrolyte, ionic conductor to allow the lithium ion diffusion through the protection and electrically insulator to avoid reduction and decomposition of liquid electrolyte by electron consumption. The objective is to delete the polysulfide redox-shuttle mechanism in Li-S batteries [1], to limit the degradation of lithium or sodium by oxygen, moisture and CO_2 dissolved in metal-air batteries [2], or still to increase the lifetime. Various ways of chemical syntheses were used as the chemisorption by electro-polymerization [3], or still spontaneous graftings or by redox way [4]. Various works were led on the in-situ polymerization, formation of Zintl salts, or formation of ionic conductive monolayer [5-7]. More recently, coatings with silane showed promising performances in the protection of metallic lithium [8]. New protections adapted to the application are necessary, in particular in the case of Metal-air and Li-S batteries. It is in this context that is developed this PhD project with the objective to obtain a hybrid system from metallic lithium protected by a

	modified compound with strong links with lithium surface. Different chemical treatments (liquid, gas, in-situ) and aging will be performed on naked metal surface. Particularly, the preparation and the modification of the various molecules as the stage of grafting will be performed in LRCS. Different techniques will be used to characterize and establish relationship between surface, syntheses, electrochemical properties and aging. In IPREM in Pau will be analyzed the state of metallic surface according to the pre-treatment, the influence of the linking groups and aging in relationship with different batteries application. The XPS and AES analyses complementarity will allow us to understand better these various points and to optimize them.
Techniques to be used	✓ Coating, chemical modification ✓ Electrochemical techniques ✓ Surface analyses : XPS, AES, TOF-SIMS ✓ In-situ SEM
Skills of the Applicant	The candidate must preferably hold a master degree in electrochemistry or (electro)chemical engineering, or at least in chemistry. Ideally, he/she is knowledgeable in Li-ion batteries. He/she must be handy with experimental work.
Contact (s)	Mail of The advisors
List of documents to provide	CANDIDATE APPLICATIONS SHOULD COMPRISE A CV AND A COVER LETTER SPECIFICALLY HIGHLIGHTING HOW CANDIDATE'S SKILLSET IS APPROPRIATE TO THE PROPOSED RESEARCH DETAILED ABOVE