

# Protic and Aprotic Ionic Liquids in Combination with Hard Carbon for Lithium-Ion and Sodium-Ion Batteries



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The front cover artwork is provided in collaboration of the Supercapacitors Research Line from CICenergiGUNE and the Institute for Technical Chemistry and Environmental Chemistry and the Center for Energy and Environmental Chemistry Jena (CEEC Jena) of the Friedrich-Schiller-University Jena. The Front Cover illustrates a battery based on a combination of an olive pit derived hard carbon with different ionic liquids studied for both, lithium-ion and sodium-ion battery technologies. Read the full text of the article at 10.1002/batt.201800073.

## What is the most significant result of this study?

In this work we report for the first time the use of the aprotic ionic liquid Pyr<sub>14</sub>TFSI and the protic ionic liquid Pyr<sub>H4</sub>TFSI in combination with olive pits derived hard carbon electrodes in view of the realization of advanced Li-ion and Na-ion batteries. We show that in the case of Li-based systems, both classes of ionic liquids can be successfully used at room temperature to build high performance and stable hard carbon-based systems. In the case of Na-ion chemistry, Pyr<sub>14</sub>TFSI appears to be very promising while the use of Pyr<sub>H4</sub>TFSI is not applicable due to the lack of electrochemical stability below 1 V vs. Na/Na<sup>+</sup>.

## How did each team collaborator contribute to the work?

This work was developed in collaboration between CICenergiGUNE (Vitoria-Gasteiz, Spain) and the Friedrich-Schiller University (Jena, Germany) within the framework of the PhD of M. Arnaiz. The hard carbon material was synthesized in CICenergiGUNE, while the electrolytes and the electrochemical measurements were prepared and run in the Center for Energy and Environmental Chemistry Jena.

## Does the research open other avenues that you would like to investigate?

Further studies are necessary to better understand the performance of hard carbon electrodes in aprotic ionic liquids and particularly in protic ionic liquids both in Li- and Na-ion chemistries. In this context, it is necessary to gain insight into the solid electrolyte interphase (SEI) formation in the different electrode-electrolyte combinations and its impact in the electrochemical performance.

## What other topics are you working on at the moment?

The authors from CICenergiGUNE are mostly working in the development of high energy-to-power ratio hybrid Li- and Na-ion capacitors, whereas, the authors from Friedrich-Schiller University are more focused on the development of electrolytes for both batteries and supercapacitors.

## Acknowledgments

Authors would like to thank the Deutsche Forschungsgemeinschaft (DFG) for the financial support and the Ministry of Education, Sport and Culture from Spain for granting M. Arnaiz for her PhD internship in the group of Prof. Andrea Balducci.