# Green design of lithium metal battery

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Lithium metal batteries are considered the next frontier and one of the most promising candidates for high energy density energy storage devices. The increased demand of electrochemical storage is leading the research towards new sustainable materials, to reduce their environmental and economic impact [1,2]. Lithium metal anode features the lowest negative electrochemical potential of -3.040 V (V vs standard hydrogen electrode) and a theoretical capacity of 3860mAh $g^{-1}$. These features are fundamental to improve power and energy density of li-ion batteries. However, this material is still affected by unsolved problems that limits its industrial adoptions [3,4]. The use of ionic liquid as electrolytes can mitigate these problems forming a SEI with good characteristics. Moreover, ionic liquids have low vapor pressure and non-flammable properties that can enhance safety properties of li-metal batteries [5,6]. Metallic lithium can be combined with high potential cathodes to reach outstanding performances. Today, cathode electrodes are produced by exploiting F-based polymers binders, such as poly(vinylidene difluoride) (PVdF) which needs N-methyl-2-pyrrolidone (NMP) as solvent/dispersant, both very toxic for humans and environment. Transition to aqueous electrode processed in combination with natural polymers is expected to provide a great step forward towards an ideally sustainable and environmentally friendly technology for energy storage systems [7]. In this work we present a preliminary study on a high voltage cathodes prepared with water processable binders combined with lithium metal anode and ionic liquid electrolytes.

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[1] F.Poli, D. Momodu, G. E Spina, A. Terella, B. K. Mutuma, M. L. Focarete, N. Manyala, F. Soavi, *Electrochim. Acta* **2020,** 338 , 135872

[2] D. Bresser, D. Buchholz, A. Moretti, A. Varzi, S. Passerini, *Energy Environ. Sci.* **2018**, 11, 3096.

[3] Y. Zhang et al., *Mater. Today Commun.*, **Mar. 01, 2020**, vol. 33. pp. 56–74,

[4] X. B. Cheng, R. Zhang, C. Z. Zhao, and Q. Zhang, *Chem. Rev.* **2017**, 117, 15, 10403–10473,

[5] J. R. Nair et al., *J. Power Sources*, **2019**, 412, 398

[6] S. Brutti et al., *J. Power Sources*, **2020**, 479, 228791

[7] G. E. Spina, F. Poli, A. Brilloni, D. Marchese, F. Soavi, *Energies*, **2020**, *13*(12), 3115