Sustainable methods for lithium recovery from unconventional resources

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Lithium is one of the most critical elements in today's economy in light of its use in both primary and secondary batteries and their wide use in portable electronics, hybrid vehicles, precision electronics and smart grids. Unfortunately, as the market for this element increases, their availability does not, hence the need to harvest it from unconventional resources. In the past years, many attempts at recovering lithium from concentrated brine solutions have been made, by both pure adsorption and electrochemical processes. However, only a few pilot plants exist that commercially extract lithium from aqueous solutions nowadays as an alternative to the popular evaporitic technique.

In this work we present two different approaches to recover lithium from unconventional resources. The first method consists in pressure-assisted filtrations of diluted solutions through a functionalized graphene-oxide membrane. A lithium selective crown ether molecule was grafted onto the graphene oxide flakes and a polymeric binder was also added to the formulation. By combining the selectivity of the crown ether with the properties of highly stacked graphene oxide membranes obtained by preparing it under vacuum, 70% of lithium was recovered from a 1 mM lithium solution.[1] The second methodology proposed involves instead the hydrothermal conversion of TiO_2 nanotubes into $LiTiO_x$ and their use in electrochemical systems. This structure is highly stable in both morphology and composition and can store up to 17 at.% of lithium while working in organic electrolyte. Furthermore, the lithium thus stored can be extracted by static acidic de-lithiation without compromising either its structural or electrochemical integrity. In light of their stability, these electrodes could be also used in aqueous environment.[2]

[1] L. Baudino, A. Pedico, S. Bianco, M. Periolatto, C.F. Pirri and A. Lamberti, *Membranes*, 12 (2022) 233.

[2] L. Baudino, P. Zaccagnini, N. Garino, M. Serrapede, M. Laurenti, A. Pedico, C.F. Pirri and A. Lamberti, *ChemElectroChem*, (2022) e202101652.