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Efficient recovery of metallic lithium by electrodeposition from organic media

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Introduction and Experimental

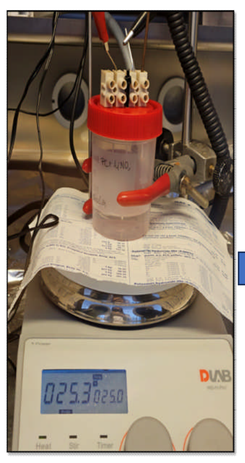
Efficient recovery of metallic lithium by electrodeposition from organic media is a subject of increasing importance, particularly in the context of lithium-ion batteries and other energy storage technologies. The process typically involves extracting lithium ions from solutions and depositing them as metallic lithium on an electrode surface using electrochemical techniques.

This recovery method can be more energy-efficient, environmentally friendly, and selective compared to other traditional methods.The efficient recovery of metallic lithium (Li) by electrodeposition in a glove box, from organic media such as dimethyl sulfoxide (DMSO) with lithium nitrate (LiNO□) as a lithium source is a key research topic in the field of energy storage, particularly for lithium-ion batteries. DMSO is an attractive solvent due to its high dielectric constant, ability to dissolve a wide range of salts, and relatively low volatility. The use of LiNO□ in DMSO forms a lithium-rich electrolyte. The concentration of LiNO□ plays a significant role in the efficiency of the process, as it governs the ionic conductivity of the electrolyte and the driving force for lithium deposition and we chossed a 10 wt% $LiNO_3$.

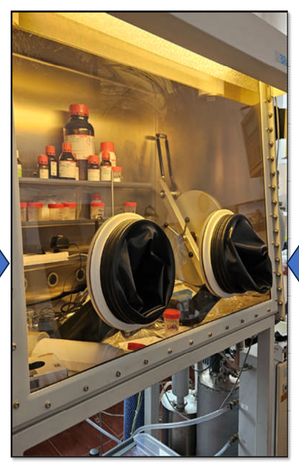
We used a Parstat 4000 potentiostat, a Cu working electrode,a Pt as a quasi reference electrode and Pt foil as a counter electrode. The potential applied to the working electrode should be carefully controlled to ensure that lithium deposits (proved by cyclic volttametry measurements) rather than unwanted side reactions (demonstrated by FTIR measurments on the electrolyte before and after electrodeposition) like oxygen evolution or solvent decomposition occur. The applied potential must be controlled also to ensure that lithium metal is deposited efficiently taking in account that the overpotentials for lithium electrodeposition in DMSO-based systems are typically higher compared to aqueous systems due to the difference in solvation dynamics of lithium ions in organic solvents. The rate of lithium deposition is dependent on the applied current density. High current densities might lead to the formation of rough or dendritic lithium deposits (which can affect the efficiency and long-term stability of the deposition process) and also can make decomposition of DMSO.

The structure, morphology and composition of the electrodeposit deposit was determine by XRD, SEM and ICP-OES. The morphology of lithium deposits plays a key role in determining the efficiency of the process. Smooth, compact lithium deposits are more desirable because they minimize the risk of short-circuiting or mechanical failure in applications such as batteries. .

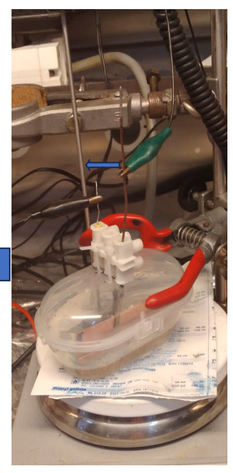
Results



Deposition cell



Dry box filled with Ar



Deposition cell

Fig 1. Laboratory experimental conditions

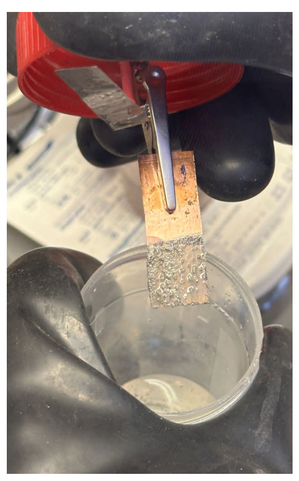


Fig 1. Different lithium deposits obtained

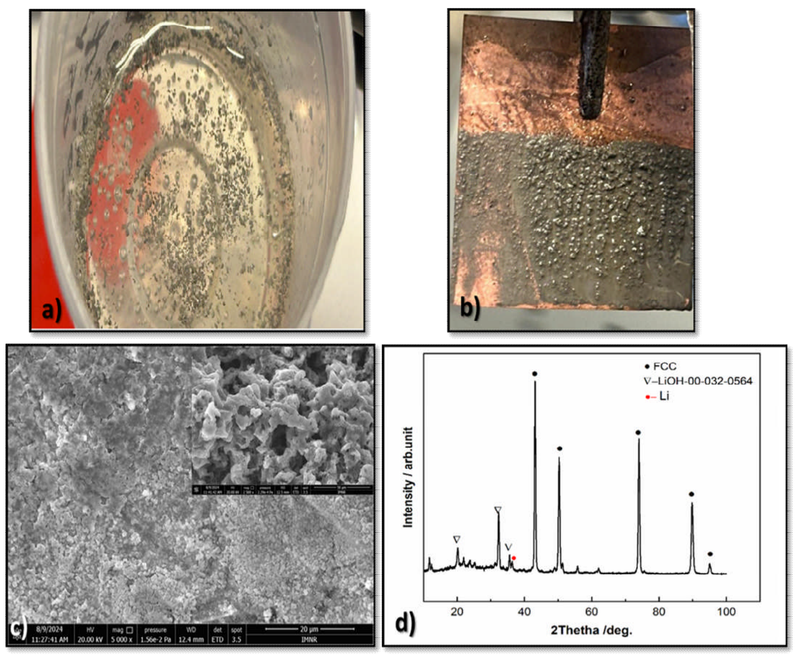


Fig 2. **DMSO-$LiNO_3$: a) Li particles floating in electrolyte; b) deposit on Cu; c) SEM image of the deposit; d) XRD diffraction pattern of the deposit**

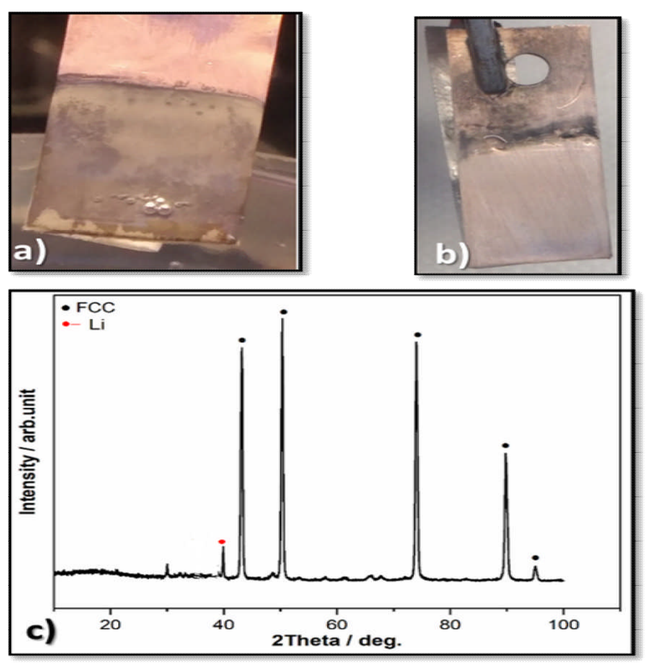


*Fig 3.***DMSO-$LiNO_3$ electrolysis: a) metallic lithium bubbles; b) smooth lithium; c) XRD diffraction pattern of the deposit**

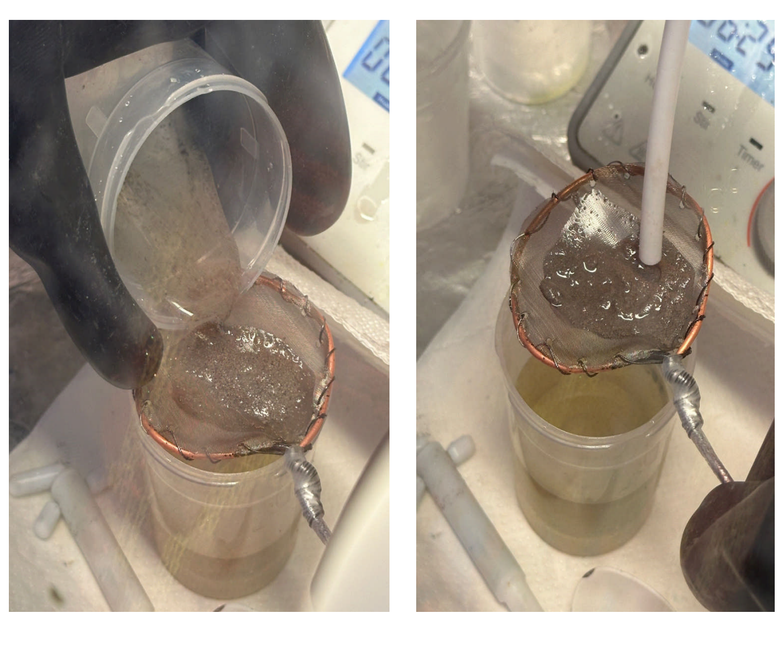


Fig 4. **Filtration of Li particles floating in the electrolyte and drying with Ar of traces of electrolyte**

Experimental determined and calculated [Efficiency%=(actual mass deposited/theoretical mass deposited)*100] deposition efficiency range from 57.97% to 92% depending on haw well all the factors presented above were optimized.

Acknowledgment

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