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A new extraction system based on the TBPS/thymol hydrophobic deep eutectic solvent

I.V. Zinov'eva (*iz@igic.ras.ru*), T.Yu. Chikineva, Yu.A. Zakhodyaeva, A.A. Voshkin

Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences

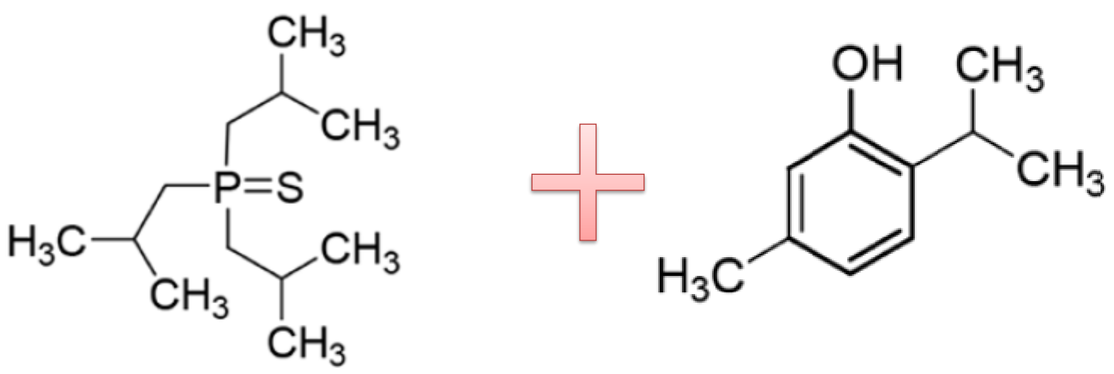
INTRODUCTION & AIM

Today, the development of new generation extraction systems is critically important for the environmentally friendly and efficient recycling of spent Li-ion batteries. Traditional organic solvents are toxic, volatile, and flammable. Hydrophobic deep eutectic solvents (HDES) offer a green alternative: they have low volatility, incombustibility, efficiency and can be obtained from their available raw materials. A large number of eutectic solvents (e.g. based on TOPO, D2EHPA, etc.) have already been studied in the literature and have proven themselves to be promising extraction systems. Their key advantage is the ability to fine–tune the composition for the selective and highly efficient extraction of valuable metals (Li, Co, Ni, Mn, etc.).

The purpose of this work is to develop a hydrophobic deep eutectic solvent based on triisobutylphosphine sulfide (TBPS) and thymol and to study its extraction properties.

METHOD

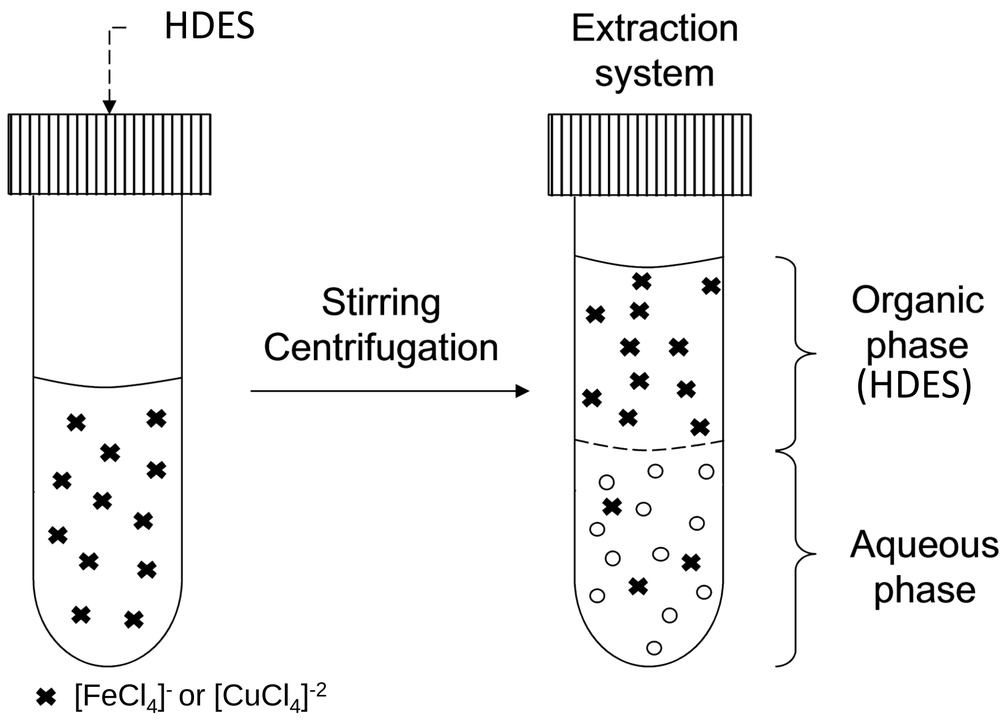
HDES preparation: stirring, 60 °C, 1h, molar ratio 1:1



TBPS thymol

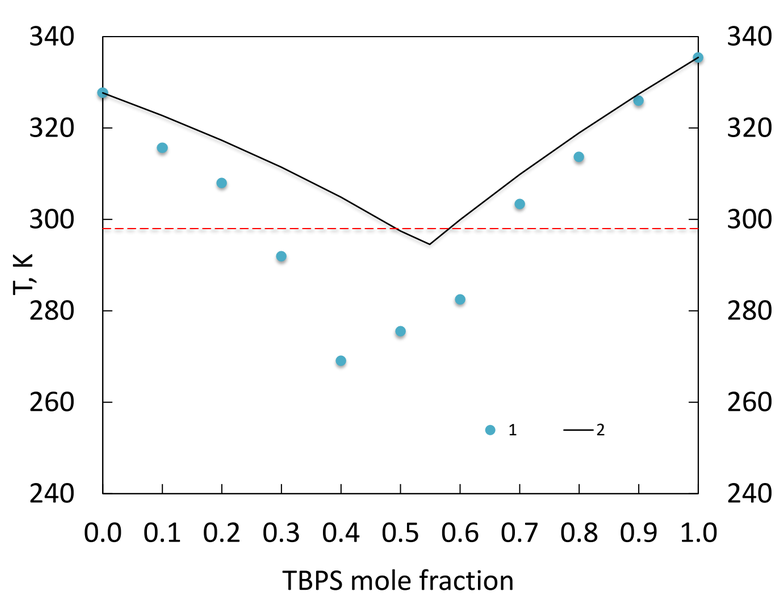
After mixing, a stable liquid phase was formed

All extraction experiments were carried out at a temperature of 25 °C and an atmospheric pressure of ~100 kPa in graduated centrifuge tubes with a thermostatically controlled shaker.

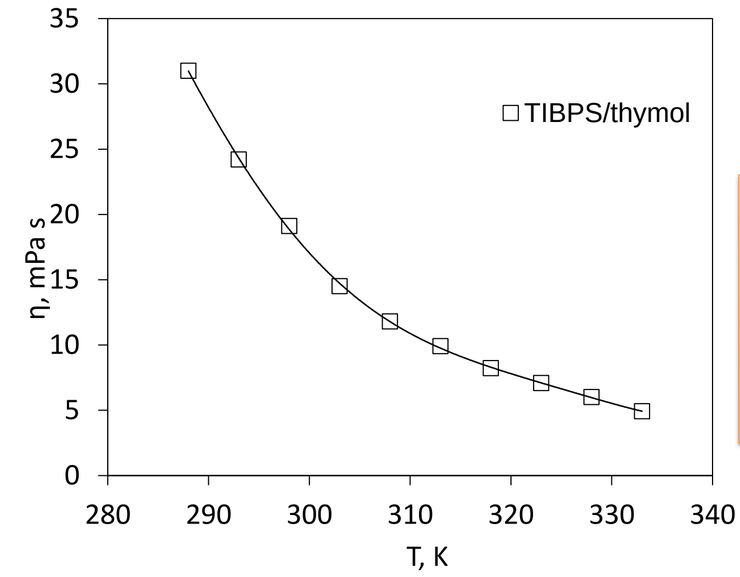


RESULTS & DISCUSSION

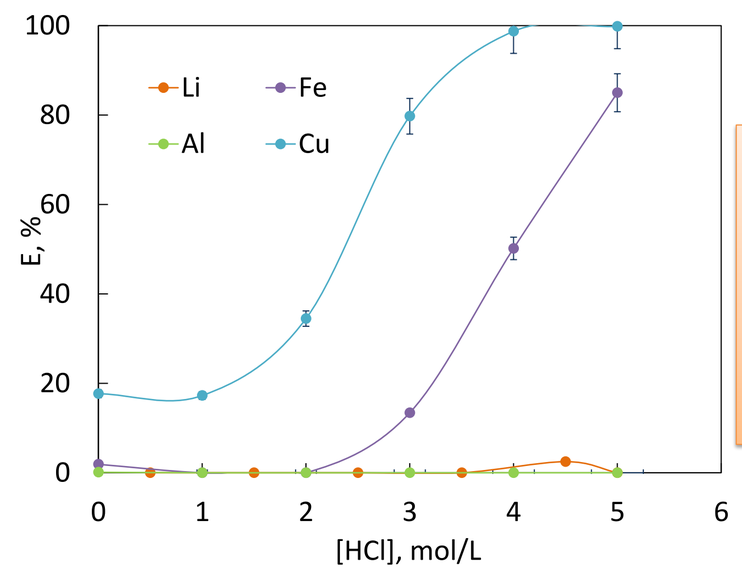
An extraction method was developed for recovery of major metal ions present in the active material of spent LFP batteries (Li, Cu, Al, and Fe).



The experimental diagrams (1) lie below the calculated ones (2) in the region near the eutectic composition for a binary mixture. This allows us to conclude that the mixture is a deep eutectic solvent.



The viscosity of the proposed eutectic solvent is below 30 mPa s, indicating their technological suitability.



It was found that it is possible to selectively isolate Cu(II) and Fe(III) with from 2 and 5 M HCl with high separation factors of 18 and 350, respectively.

CONCLUSION

Thus, the prospects of using TBPS/thymol HDES for metal ion separation contained in the active materials of spent LFP batteries are shown.

FUTURE WORK / REFERENCES

Work on studying the extraction of other metals will be continued.

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