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## Innovative approaches for recycling old batteries solution through the precipitation of ZIFs

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**THEME**

- Thème 1 : Elaboration et mise en forme de matériaux poreux
- Thème 2 : Applications pour environnement, énergie et santé
- Thème 3 : Modélisation et caractérisation de matériaux poreux

**Innovative approaches for recycling old batteries solution through the precipitation of ZIFs**

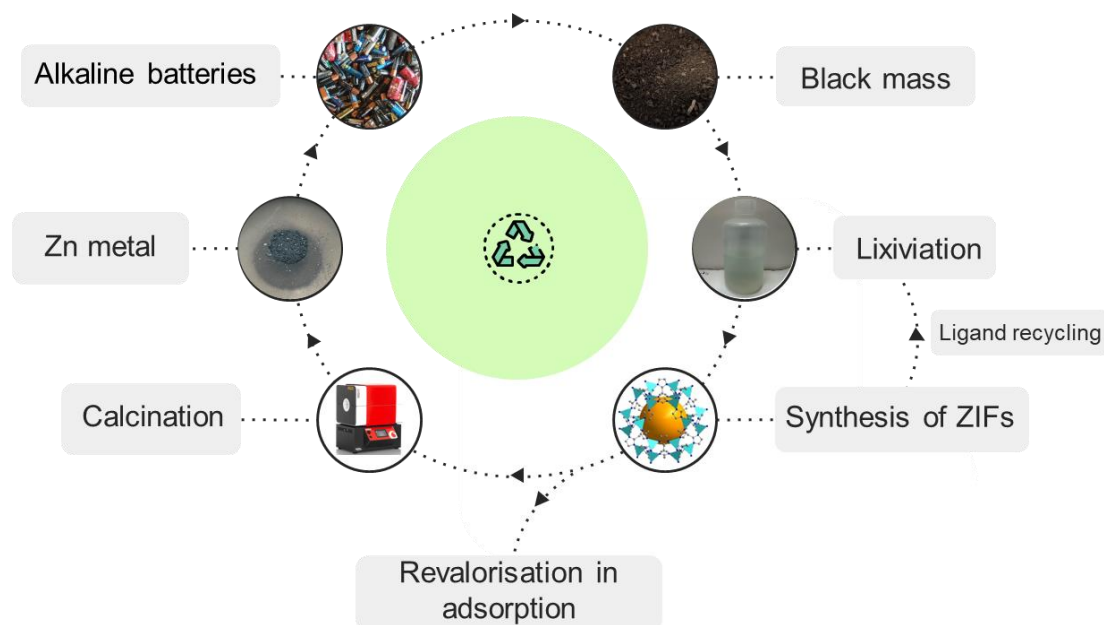
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Up to this day, the recycling process in primary batteries involves (hydro) metallurgic processes to produce drip trays, a rather high cost procedure for a low cost material. Herein, we report the selective precipitation of zinc into Zeolitic Imidazolate Frameworks (ZIFs) from a polymetallic aqueous solution, derived from a black mass sample of alkaline (primary) batteries containing metals like Zn, Mn, Ni, Cu, Al, Fe and Co. The synthesis conditions were adapted in order to switch from a methanolic to an aqueous solution, as well as using sulfate precursors instead of nitrates. With the help of benzimidazole or 2-methylimidazole, ZIF-7-III and ZIF-8 precipitated accordingly, leading to a recovery of more than 99 % of zinc in a one-step and one-pot reaction.

Both materials (ZIF-7-III and ZIF-8) were calcined in hydrogenated argon atmosphere, forming metal zinc that was collected as a deposit around the furnace tube and could be involved in the making of new alkaline or Zn-air batteries. The high BET area of ZIF-8 (1300-2000 m<sup>2</sup>/g) permits the further valorization in adsorption and the trapping of propylene and propane.

Finally, more than 50 % of the ligand can be easily recycled and used at new in the process of precipitation. Both loops involve a less energy consuming process, isolating a product of a high value. The closed loop provides a pathway in order to reassemble alkaline batteries, whereas the open loop permits the use in high-importance procedures.



**Fig. 1.** Schematic representation of the main recycling loop with the help of ZIFs.