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Novel Functionalized Polyethylene Terephthalate Nanofiber Adsorbents for Prospective Metal Recovery from Spent Lithium-Ion Batteries

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The growing demand for consumer electronics and electric vehicles has led to a substantial increase in the consumption of lithium-ion batteries (LIBs). The lack of economically viable and environmentally friendly recycling processes for LIBs could lead to an environmental crisis and resources shortage. Amongst other techniques, liquid-liquid extraction and solid-liquid extraction are the two most known concepts applied for separation and extraction of metals from aqueous solutions. Compared to the two, the former has wide applicability in hydrometallurgical processes and can handle large volume of aqueous solutions but involves high volume of organic solvents1. As a promising alternative, solid-liquid process using nanofiber adsorbents shows great potential for extracting valuable metals due to their unique properties, such as high specific surface area2. This study focused on synthesizing a novel nano-adsorbent material, polyethylene terephthalate (PET)-Di-2-ethylhexyl phosphoric acid (DEHPA). The optimal volume ratio of PET (10 wt%) and DEHPA for complete functionalization was found to be 9:1. While the electrospinning process parameters were determined to be 15 cm, 30 kV, and 1.0 mL/h. The characterization of PET and PET-DEHPA nanofibers was carried out by FTIR, XRD, TGA, SEM, and BET. The FTIR spectra of PET-DEHPA nanofibers revealed the presence of the P-O-C functional group at 1011 cm-1, while SEM micrographs displayed crosslinked nanofibers. Additionally, the TGA profiles showed that a single-step degradation at 353 ℃ for pristine PET nanofibers while the thermogram of PET-DEHPA nanofibers exhibited a two-step degradation at 240 −327 ℃ and 327 −570 ℃. Therefore, the results confirmed the successful functionalization of PET polymer nanofibers which are intended for use as adsorbents for valuable metals from spent lithium-ion batteries.

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