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A Mini-Review on Metal Recycling from Spent Lithium Ion Batteries

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ABSTRACT

The rapid growth of lithium ion batteries (LIBs) for portable electronic devices and electric vehicles has resulted in an increased number of spent LIBs. Spent LIBs contain not only dangerous heavy metals but also toxic chemicals that pose a serious threat to ecosystems and human health. Therefore, a great deal of attention has been paid to the development of an efficient process to recycle spent LIBs for both economic aspects and environmental protection. In this paper, we review the state-of-the-art processes for metal recycling from spent LIBs, introduce the structure of a LIB, and summarize all available technologies that are used in different recovery processes. It is notable that metal extraction and pretreatment play important roles in the whole recovery process, based on one or more of the principles of pyrometallurgy, hydrometallurgy, biometallurgy, and so forth. By further comparing different recycling methods, existing challenges are identified and suggestions for improving the recycling effectiveness can be proposed.

1. Introduction

Since the 1990s, lithium ion batteries (LIBs) have been widely used in portable electronic devices and electric vehicles [1–3] because of their high energy density, long storage life, small volume, light weight, low self-discharge efficiency, non-memory effect, wide range of application temperatures, and advantages in environmentally compatible operations [3–6]. However, a large

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