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Polyimides as Cathodic Materials in Lithium Batteries: Effect of the Chemical Structure of the Diamine Monomer

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ABSTRACT

Polyimides are being investigated as alternative, environmentally friendly and safe organic electrode materials for lithium and sodium batteries. However, further improvements need the proper chemical design of these polymers. In this paper, the effect of chemical structure of polyimides on their performance as cathodic materials in lithium batteries was investigated in detail. More in particular, we studied polyimides based on seven different diamine monomers in combination with best performing naphthalenic dianhydride monomer. The first set included the so-called cardo diamines possessing additional redox-active carbonyl group with the goal to enhance the theoretical capacity of the polymer. Second, several aromatic diamines including additional functionalities such as cyclic amides, anthrone, or quinolidinium groups were investigated. Finally, aliphatic diamines, containing oxyethylene moieties and thus capable to increase the ionic conductivity of the resulting polymer system, were explored. Among the different polyimides, the "cardo" one based on naphthalenic dianhydride and aromatic aniline phthalein with an additional carbonyl group showed the best results in terms of battery performance. Such polyimide was capable to deliver up to 130 $mAhg^{-1}$ specific capacity (87% of the theoretical value) at 25 °C and at a current density of 250 mAg^{-1} during 100 charge/discharge cycles. © 2018 Wiley Periodicals, Inc. J. Polym. Sci., Part A: Polym. Chem. 2018.