Electroanalytical utility of 3D printable poly(lactic acid) composites with carbon black and nanodiamond fillers

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1. Introduction

Over the past few years, the popularity of 3D printing has increased exponentially. Here, composites based on thermoplastics with conductive carbon fillers are reported for electrochemical-based applications such as sensors, batteries, and water remediation. 3D printouts offer versatility in terms of cheap and on-demand fabrication of free-standing electrodes. However, numerous issues still needs to be addressed, such as sub-optimal charge transfer kinetics and reproducibility of results, polymer composite stability etc.

2. Online submission

The results of most recent studies by our group, utilizing commercially available and self-made poly(lactic acid), PLA, with different nanocarbon fillers will be presented. Surface activation of 3D printouts (laser ablation or hydrolysis of PLA), and the effect of multiple reprocessing on percolation paths and nanocarbon agglomeration are considered to be of key importance to consider the composite for electroanalysis.

There is a great focus on the development of new conductive filaments that exhibit better mechanical, electric, thermal, and electrochemical properties. We have developed 3D printing filaments based on carbon black and detonation nanodiamonds as well as boron-doped carbon nanowalls. The goal of the research was to investigate and thoroughly understand the interactions between composite components and those that affect the thermo-mechanical parameters and electrochemical characteristics of printed elements. In particular, the enhancement of electrode kinetics and electrochemically available surface area by ND was revealed and discussed.

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