Carbon dot/polymer composites for biomedical, environmental and packaging applications

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Carbon dots (CDs) have captivated tremendous interest in multiple applications due to attractive properties from good biocompatibility to intriguing optical properties. Here we will present a facile microwave-assisted route for preparation of CDs from various biomass resources[1] and show examples of the great value and versatility of these multifunctional CDs to enhance the properties of biobased materials in packaging,[2,3] biomedical[4] and environmental[5] applications. The zero-dimensional amphiphilic CDs provide unique thermal, mechanical and barrier properties in polylactide (PLA) and PLA/starch composites for packaging applications. CDs incorporated into biomedical scaffolds demonstrate good biocompatibility and attractive bioactivity by inducing calcium phosphate mineralization on the surface of the scaffolds. This makes CDs a promising additive for bone-related biomedical applications. Furthermore, CDs can assist in drug loading and release from biomedical scaffolds. CDs also stabilized porous bioresorbable scaffolds and improved the electrospinnability of starch and PLA fibers. In environmental applications the rheological properties, swelling ratio, degree of crosslinking and adsorption capacity of chitosan and carboxymethyl cellulose hydrogels could be tuned by addition of CDs. Recently we also demonstrated that incorporation of CDs in cellulose acetate rendered the material enhanced degradability under open environment relevant conditions.[6] This was achieved by photocatalytically activated deacetylation, the bottleneck for biodegradation of cellulose acetate. The weight loss of CD modified cellulose acetate after 30 days in simulated sunlight was 43% or 53% for materials aged in artificial sea water and air, respectively. This can be compared to 4% and 12% weight loss for cellulose acetate without CDs under same conditions.

References

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