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High Density Polyethylene Biocomposites Reinforced with Hydroxyapatite Nanorods and Carbon Nanofibers for Joint Replacements

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Abstract : Since Bonfield's group's pioneer work, there has been growing interest amongst the materials scientists, biomedical engineers and surgeons in the use of novel biomaterials for the treatment of bone defects and injuries. This study focuses on the fabrication, mechanical characterization and biocompatibility evaluation of high density polyethylene (HDPE) reinforced with hydroxyapatite nanorods (HANR) and carbon nanofibers (CNF). HANRs of 20 wt% and CNFs of 0.5-2 wt% were incorporated into HDPE to form biocomposites using traditional melt-compounding and injection molding techniques. The mechanical measurements show that CNF additions greatly improve the tensile strength and Young's modulus of HDPE and HDPE-20% nHA composites. Meanwhile, the nHA and CNF fillers were found to be effective to improve dimensional and thermal stability of HDPE. The results of osteoblast cell cultivation and dimethyl thiazolyl diphenyl thiazolyl tetrazolium (MTT) tests showed that the HDPE/ CNF-nHA nanocomposites are biocompatible. Such HDPE/ CNF-nHA hybrids are found to be potential biomaterials for making orthopedic joint/bone replacements.

Keywords : biocompatibility, biocomposite, carbon nanofiber, high density polyethylene, hydroxyapatite
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