Effects of carbon doping on the microstructural, micro/nano-mechanical, and mesenchymal stromal cells biocompatibility and osteogenic differentiation properties of alumina

It has been demonstrated that carbon (C) doped aluminium oxide (Al₂O₃) nanocomposite (C ~0.012wt%) had greater wear resistance and lower surface grains pull out percentage when compared with monolithic Al₂O₃. In the present study, we investigated the physicochemical, micro- and nanomechanical, cell attachment, in vitro biocompatibility and osteogenic differentiation properties of Al₂O₃ doped carbon (0.012wt%) nanocomposite (Al₂O₃/C). Data were compared to values obtained for monolithic alumina (Al₂O₃). The calcined Al₂O₃/C nanocomposite was densified using cold isostatic pressing and followed by pressureless sintering. For physicochemical and microstructural characterisation, Energy dispersive X-ray (EDX), X-ray diffraction (XRD), Raman spectroscopy, and X-ray photoemission spectrometer (XPS) were used. EDX, XRD peaks and Raman spectroscopy demonstrated correlating to Al₂O₃/C. Surface profiling and contact angle investigations demonstrated highly contoured micro-surface topography. The micro and nano-hardness indicate an improved wear resistance of the Al₂O₃/C when compared with monolithic Al₂O₃. SEM, confocal images and alamar blue reduction assay suggested good cell attachment and proliferation of human bone marrow derived mesenchymal stromal cells (hBMSCs). Osteogenic protein and gene expression indicated Al₂O₃/C had a significant osteogenic potential (p

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Contributors: Krishnamurithy, G., Yahya, N. A., Mehrali, M., Mehrali, M., Mohan, S., Murali, M. R., Raghavendran, H. R. B., Kamarul, T.
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