World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:16, No:07, 2022

Titanium Nitride Nanoparticles for Biological Applications

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Abstract : Titanium nitride (TiN) nanoparticles have sparked interest over the past decade due to their characteristics such as thermal stability, extreme hardness, low production cost, and similar optical properties to gold. In this study, TiN nanoparticles were synthesized via a thermal benzene route to obtain a black powder of nanoparticles. The final product was drop cast onto conductive carbon tape and sputter coated with gold/palladium at a thickness of 4 nm for characterization by field emission scanning electron microscopy (FE-SEM) with energy dispersive X-Ray spectroscopy (EDX) that revealed they were spherical. ImageJ software determined the average size of the TiN nanoparticles was 79 nm in diameter. EDX revealed the elements present in the sample and showed no impurities. Further characterization by X-ray diffraction (XRD) revealed characteristic peaks of cubic phase titanium nitride, and crystallite size was calculated to be 14 nm using the Debye-Scherrer method. Dynamic light scattering (DLS) analysis revealed the size and size distribution of the TiN nanoparticles, with average size being 154 nm. Zeta potential concluded the surface of the TiN nanoparticles is negatively charged. Biocompatibility studies using MTT(3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide) assay showed TiN nanoparticles are not cytotoxic at low concentrations (2, 5, 10, 25, 50, 75 mcg/well), and cell viability began to decrease at a concentration of 100 mcg/well.

Keywords : biocompatibility, characterization, cytotoxicity, nanoparticles, synthesis, titanium nitride
Conference Title : ICNMR 2022 : International Conference on Nanostructured Materials and Research
Conference Location : Toronto, Canada
Conference Dates : July 19-20, 2022