Abstract

Pulsating water jet technology introduces the capability to create a distinct 3D surface architecture, morphology, and roughness, potentially improving the osseointegration rate. This method employs pure water, ensuring a medically clean surface without implant contamination from undesirable particles, emphasizing its effectiveness and environmental friendliness. The application of pulsating water jets induces surface structuring and subsurface modification, particularly in the dislocation substructure. Beyond impacting mechanical properties like fatigue, hardness, or wear, it also influences surface properties such as wettability and surface energy. Achieving a functional surface with defined properties necessitates precise tuning and optimization of various process parameters. The predictive modeling of specific biometals' (Ti and AISI alloys) erosion stages using pulsating water jets and machine learning approaches can significantly contribute to foreseeing and selecting the optimal parameter combinations, leading to desired outcomes. This study focuses on predictive modeling specifically for pulsating waterjet erosion on biometals, presenting a comprehensive analysis of their erosive behavior under dynamic waterjet conditions. Through the development and application of predictive models, the research aims to unravel the intricate relationship between pulsating waterjet parameters and biometals' erosion characteristics. The investigation encompasses diverse factors such as material composition, surface morphology, and erosion rates, offering a nuanced understanding of erosive processes. The study's findings not only advance predictive capabilities in waterjet erosion modeling but also have substantial implications for designing and optimizing biometal components exposed to pulsating waterjet environments. The integration of predictive models in this context represents a crucial step toward enhancing the durability and performance of biometals in practical applications.