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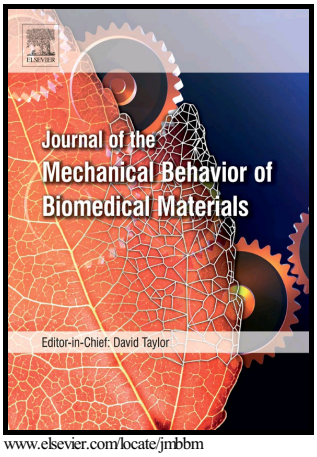

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Detection of Degradation in Polyester Implants by Analysing Mode Shapes of Structure Vibration

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Abstract

This paper presents a numerical study on using vibration analysis to detect degradation in degrading polymesters. A numerical model of a degrading plate sample is considered. The plate is assumed to degrade following the typical behaviour of amorphous copolymers of polylactide and polyglycolide. Due to the well-known autocatalytic effect in the degradation of these polyesters, the inner core of the plate degrades faster than outer surface region, forming layers of materials with varying Young's modulus. Firstly the change in molecular weight and corresponding change in Young's modulus at different times are calculated using the mathematical models developed in our previous work. Secondly the first four mode shapes of transverse vibration of the plate are calculated using the finite element method. Finally the curvature of the mode shapes are calculated and related to the spatial distribution of the polymer degradation. It is shown that the curvature of the mode shapes can be used to detect the onset and distribution of polymer degradation. The level of measurement accuracy required in an experiment is presented to guide practical applications of the method. At the end of this paper a demonstration case of coronary stent is presented showing how the method can be used to detect degradation in an implant of sophisticated structure.

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