Finite Element Model for the Transport Swelling of Gelatin Methacrylate with Particles

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Abstract: In recent years, the improvement of biomedical materials and their applications have gained much interest and been broadly discussed. Hydrogel, gelatin methacrylate (GelMa), is one of the applications with the greatest potential, such as cell culture, and studied by many researchers. In this study, a system consisting of GelMa and the special particles which can be aligned by applying electric field is developed. The alignment of the particles can alter the curvature of the GelMa substrate. The proposed system which provides the mechanical stimulus to the cell attached on the system due to different deformation curvatures can be used as a carrier of cell culture. In order to reveal the relationship between the alignment of the particles and the resulting curvature, a user-defined element subroutine in the commercial finite element software package Abaqus to predict the mechanical behavior, especially the curvature of the GelMa substrates, is developed. Different patterns of particles are simulated and the predicted curvatures of the GelMa substrates are compared with those measured in experiments, having good agreements. The results are expected to provide design guideline to the novel tissue engineering system, which is beneficial to the field of organ and tissue regeneration.

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