

In the field of biomaterial design there is growing interest in the development of new smart materials, materials that can be actuated by external stimuli to alter shape. Controlling a material's shape by external stimuli allows objects to have additional functionality and imparts new methods of control. Agarose is one such actuating biomaterial that is additionally non-toxic, biodegradable, and readily alters shape with moisture, either expanding or contracting. These expansions and contractions are normally imprecise and chaotic, but with the addition of a passive material to act as a scaffold by which to direct agarose's movement, precision and control can be achieved. Furthermore, scaffold design and integration into agarose films can be varied, being accomplished by either casting agarose gel onto a scaffold in a mold during film gelation, precisely extruding agarose gel onto a scaffold by 3D printing, or through the injection of a crystalizing solution into an agarose gel. Agarose film composition provides a further avenue to control shape through film composition with the addition of crosslinking agents and the formation of hydrogen bonds leading to variations in bending forces. Taken together, this study aims to examine agarose films of varying composition and intermolecular forces and combine them with scaffolds of varying patterns and polymeric materials to discover the connections between film composition, scaffold design and ultimate shape morphing capabilities. To understand the structural morphology of the agarose composites, various analytical techniques will be implemented including Fourier transform infrared spectroscopy (FTIR), thermal gravimetric analysis (TGA), tensile strength, strain gauge measurements, and X-Ray scattering.