DEVELOPMENT OF 3D CELLLULAR SILICONE STRUCTURES USING REACTIVE INKJET PRINTING APPROACH FOR ENERGY ABSORBING APPLICATION

Aleksandra Foerster, University of Nottingham,
aleksandra.foerster@nottingham.ac.uk
Anna Terry, AWE Plc, Aldermaston, Reading
Ricky Wildman, University of Nottingham, University Park, Nottingham
Richard Hague, University of Nottingham, University Park, Nottingham
Christopher Tuck, University of Nottingham, University Park, Nottingham

Key Words: Reactive inkjet printing, silicone, 3D cellular structures, cross-linking, energy absorption

Silicone cellular foams are well suited for energy absorbing applications due to their ability to undertake large deformations and absorb significant quantities of energy. However traditional methods for fabrication of cellular silicone are long and difficult and with no possibility of varying the density of pores. Having a fabrication method that allows controlling the structure hence mechanical properties of the silicone features is essential for expanding their application.

This work investigates a method based on reactive inkjet printing approach to produce 3D silicone structures of which mechanical properties can be tailored by varying the process parameters and structure's design. Printing parameters such as pressure, temperature, and pulse shape were investigated to optimize the process for SE1700 silicone material. The vinyl terminated part of SE1700 silicone with the addition of different solvents (vinyl terminated polydimethylsiloxane, silicone oil 10cP and 100cP) were evaluated for printability using rheology. The mechanical properties of printed films were assessed using dynamic mechanical analysis and tensile testing. The TGA and swelling study were performed to understand the change in sample's properties in relation to different formulations. Silicone structures with different porosities were printed and the storage modulus, loss modulus and damping properties were investigated. The results showed that despite the high viscosity of silicone fluids, it is possible to employ reactive inkjet printing approach in order to obtain silicone features. It was also demonstrated that the capability to alter mechanical properties of printed silicone structures could be achieved using different process parameters and also by different structure design.