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Influence of Injection Moulding Processing Parameters on Material Acoustic Properties for the Manufacturing of Polymer Micro-acoustic-fluidic Systems

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Abstract

In the optimization of acoustic-based polymer microanalytics devices, the influence of injection moulding parameters on the acoustic attributes of polymers must be comprehended. In this study, the effects of specific injection moulding parameters, notably injection speed and packing pressure, on the acoustic properties of polymers were examined. Through the research conducted, material parameters such as Young's modulus and Poisson's ratio were determined. Polymethyl methacrylate (PMMA) was chosen as the primary moulding material. Using PMMA LG IG 840, the parts were simulated and injection moulded. The design of experiment (DOE) statistical approach was utilized to ensure the validity and reliability of the findings. A distinct relationship between the injection moulding process parameters and the acoustic properties, especially the elastic moduli, was revealed by the results. A discernible decline in acoustic properties was observed as the injection velocity was increased. By applying method, the adjustment of material properties to meet specific application requirements can be facilitated through the moulding optimization. The process of characterizing the acoustic properties of various polymers, essential for the progression of acoustic-based polymer devices, is here shown and a method is established to swiftly measure polymers' acoustic parameters.

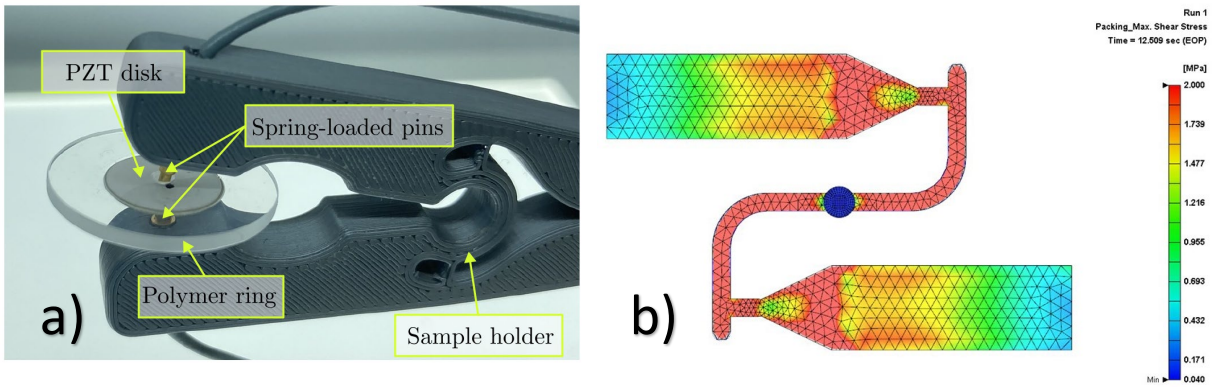

Figure 1: a) Sample holder used as part of the ultrasound electrical-impedance spectroscopy (UEIS) setup for the electrical impedance measurements. The measurements provided the acoustic parameters of the moulded PMMA components after they have been cut into disks. b) Injection moulding finite element simulations were performed to predict the shear stress of the parts and compared with the moulded parts.