Characterisation of the surface topography evolution of an ink-jet printed transparent fluoroplastic with coherence scanning interferometry

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Abstract: We present the results of an empirical investigation into the evolution of the morphology of an ink-jet printed transparent polymer using coherence scanning interferometry (CSI). CSI is a high precision optical surface measuring technique, which has been selected for this application since it can perform relatively fast (compared to contact methods) non-contact areal surface topography measurement of transparent parts [1]. Transparent thin films can be challenging to measure with optical surface measuring techniques, given that film effects can distort the measurement of the top surface topography [2]. In CSI, a transparent film will generally produce an additional signal from the substrate, which can be well separated if the film is sufficiently thick. However, when the film thickness is less than a micrometre, signals from the surface and substrate may merge, therefore, making their separation a more complex task [2,3]. The investigated features on the printed parts can range from a few nanometres to tens of micrometres in height, and from tens of micrometres to a few millimetres in wavelength. Some features present high slope angles that meet or even surpass the numerical aperture limitation of the employed objective lenses. We demonstrate the ability of CSI to characterise these challenging features in terms of data coverage, surface topography repeatability, measurement time and area. The measurements include the use of a combination of measurement parameters and the use of advanced functions, such as signal oversampling [4] and film analysis. There is currently a lack of knowledge regarding how some polymers, in this case THV 221 [5,6], can be ink-jet printed and an analysis of the areal surface topography measured by CSI can provide a better understanding of the features and characteristic textures that result from the ink-jet printing process. Most THV applications include multilayer parts, where a thin layer can be used as a protective coating or to provide enhanced barrier properties to other layers [6,7]. This investigation also provides an insight in to how to control and optimise the quality of THV 221 printed parts. Relevant printing parameters, including number of layers, THV concentration and drop separation, have been selected and varied to produce the samples used for the experimental work. A variety of basic geometries, such as dots, lines and films have been considered.

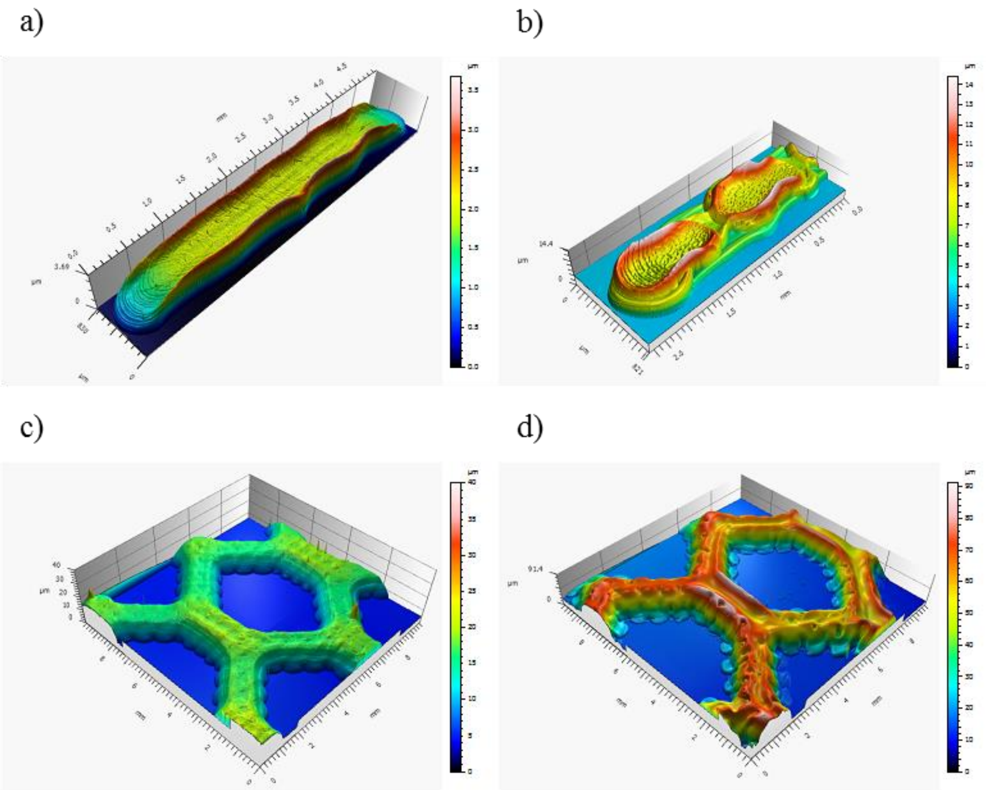

Figure 1. CSI measurements of ink-jet printed fluoroplastic THV 221 geometries, each example corresponding to 10 weight percent lines formed by a) a single layer, b) three layers, and 20 weight percent honeycombs (hexagonal lattices) formed by c) a single layer, d) three layers.

Main References

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