THz imaging of injection-mold weld lines in ABS thermoplastic

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Stagnating weld lines, a common defect in injection-mold thermoplastic products, form where two separate melt fronts impinge head-on and after which there is no subsequent flow. The presence of weld lines will degrade the mechanical properties of injection-mold products significantly. To date, the most common approach used to identify weld lines is destructive mechanical testing. In this work, terahertz (THz) reflective imaging and scanning acoustic microscopy (SAM) were utilized for material characterization as well as quality control of an injection-mold thermoplastic electrical receptacle plate.

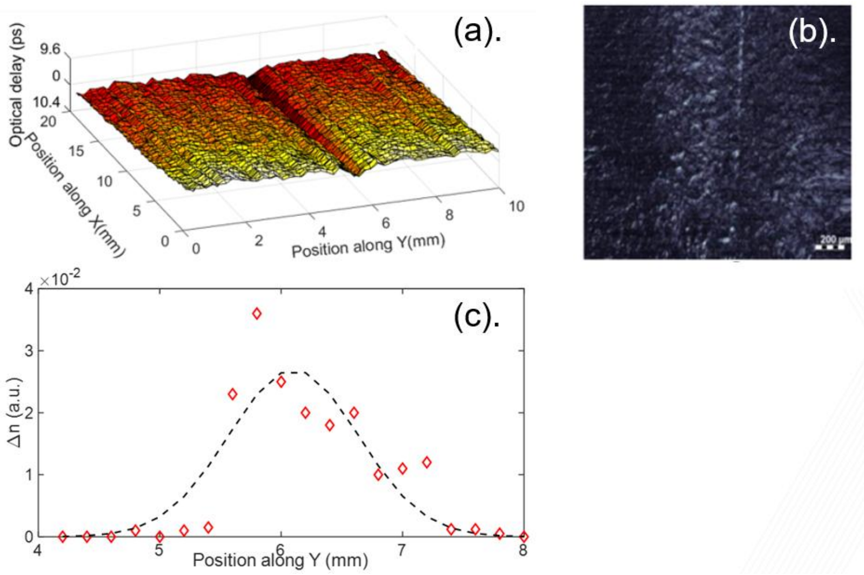

Fig. 1. (a). THz C-scans based on the peak reflected signal arrival time used as contrast mechanism. (b). SAM micrographs operating at center frequency *f* =420 MHz. (c). Birefringence along a section perpendicular to weld line.

The surface morphology of the injection-mold plastic samples was characterized using THz reflective imaging and SAM, shown in Fig. 1 (a)-(b). V-shaped weld lines are observed clearly in both THz and SAM results, and its corresponding width and depth are ~400 μm and ~10 μm, respectively.

Owing to the microstructure of weld lines, birefringence which corresponds to the magnitude of anisotropy, is also worthy of study. Spatially dependent THz birefringence is observed in Fig. 1 (c). We find that enhanced THz birefringence is localized around the weld line, and decreases gradually with the distance away from the weld line, demonstrating that the anisotropic state related to the frozen-in molecular orientation and internal stress transforms to isotropic state as the ABS moves away from the weld line. Micro-elastic heterogeneity resolved in acoustic micrographs validates the location-dependent birefringence observed in THz results.

References:

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