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Photothermal coherence tomography for 3-D visualization and structural non-destructive imaging of a wood inlay

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Abstract

The aim of this research is to investigate the suitability of truncated correlation photothermal coherence tomography (TC-PCT) for the non-destructive imaging of a replica of a real inlay to identify subsurface features that often are invisible areas of vulnerability and damage. Defects of inlays involve glue-rich areas, glue-starved areas, termite attack, insect damage, and laminar splitting. These defects have the potential to result in extensive damage to the art design layers of inlays. Therefore, there is a need for an imaging technique to visualize and determine the location of defects within the sample. The recently introduced TC-PCT modality proved capable of providing 3-D images of specimens with high axial resolution, deep subsurface depth profiling capability, and high signal-to-noise ratio (SNR). Therefore, in this study the authors used TC-PCT to image a fabricated inlay sample with various natural and artificial defects in the middle and top layers. The inlay in question reproduces to scale a piece of art preserved in the "Mirror room" of the *Castle Laffitte* in France. It was built by a professional restorer following the ancient procedure named *element by element*. Planar TC-PCT images of the inlay were stacked coherently to provide 3-D visualization of areas with known defects in the sample. The experimental results demonstrated the identification of defects such as empty holes, a hole filled with stucco, subsurface delaminations and natural features such as a wood knot and wood grain in different layers of the sample. For this wooden sample that has a very low thermal diffusivity, a depth range of 2 mm was achieved.

Keywords

Truncated Correlation Photothermal Coherence Tomography, Wood, Inlay, Non-Destructive Testing (NDT)