Microhardness Depth Profiles Retrieved from Frequency Scanned Photothermal Measurements

H.G. Walther [C, S]
Institute of Optics and Quantum Electronics, Jena, Germany

Thermal wave techniques offer the capability for non-destructive, remote and depth resolved material inspection and characterization. Depth resolution, which is typically in the µm-range can be achieved either by variation of the modulation frequency or by appropriate variation of the excitation wavelength. One of the promising application fields of photothermal measuring techniques is depth profiling. It makes use of the fact that the diffusion of thermal energy is strongly influenced by the spatial distribution of local thermal properties which are controlled by the material's microstructure. The capability of depth profiling from inverted photothermal data is demonstrated by inspecting surface hardened steel specimens. The estimation of microhardness profiles in case hardened steel is based on the correlation between local microstructure and microhardness and between microstructure and local thermal conductivity. We demonstrate the retrieval of thermal conductivity profile from frequency scanned radiometric measurements of the sample's surface temperature. Therefore, the hardness depth profile can be calculated knowing the corresponding correlation curve.