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Scattering of High frequency Guided Waves at Surface Defects in Monocrystalline Silicon Wafers

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In the photovoltaic industry, monocrystalline silicon wafers are employed for solar cells with high conversion efficiency. Micro-cracks can be induced in the thin wafers during the panel manufacture. High frequency guided waves allow for the monitoring of the wafers and characterization of defects. The material anisotropy of the monocrystalline silicon leads to variations of the guided wave characteristics, depending on the guided wave mode and propagation direction relative to the crystal orientation. Selective excitation of the first anti-symmetric A_0 guided wave mode was achieved experimentally using a custom-made wedge transducer. Noncontact laser interferometer measurements allowed the characterization of the Lamb wave scattered field in the vicinity of artificial defects. The surface extent of the defects of varying size was characterized using an optical microscope. The guided wave propagation and scattering at shallow surface defects were investigated using time explicit 3D Finite Element modelling in ABAQUS and the influence of defect size on the magnitude and directionality of the scattering quantified. The characteristics of the scattered wave field were correlated to the defect size and the detection sensitivity discussed.

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