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Imaging 255nm Tungsten Thin Film Adhesion with Picosecond Ultrasonics

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Abstract : In the electronic or in the photovoltaic industries, components are made from wafers which are stacks of thin film layers of a few nanometers to serval micrometers thickness. Early evaluation of the bounding quality between different layers of a wafer is one of the challenges of these industries to avoid dysfunction of their final products. Traditional pump-probe experiments, which have been developed in the 70's, give a partial solution to this problematic but with a non-negligible drawback. In fact, on one hand, these setups can generate and detect ultra-high ultrasounds frequencies which can be used to evaluate the adhesion quality of wafer layers. But, on the other hand, because of the quiet long acquisition time they need to perform one measurement, these setups remain shut in punctual measurement to evaluate global sample quality. This last point can lead to bad interpretation of the sample quality parameters, especially in the case of inhomogeneous samples. Asynchronous Optical Sampling (ASOPS) systems can perform sample characterization with picosecond acoustics up to 106 times faster than traditional pump-probe setups. This last point allows picosecond ultrasonic to unlock the acoustic imaging field at the nanometric scale to detect inhomogeneities regarding sample mechanical properties. This fact will be illustrated by presenting an image of the measured acoustical reflection coefficients obtained by mapping, with an ASOPS setup, a 255nm thin-film tungsten layer deposited on a silicone substrate. Interpretation of the coefficient reflection in terms of bounding quality adhesion will also be exposed. Origin of zones which exhibit good and bad quality bounding will be discussed.

Keywords : adhesion, picosecond ultrasonics, pump-probe, thin film
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