Advanced Use of Therma-Probe for Ultra-Shallow Junction Monitoring

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ABSTRACT

Therma-Probe® (TP) is widely used in the semiconductor industry for the SPC monitoring of the various ion implantation steps included in the Complementary Metal Oxide Semiconductor process. This fully optical, hence non-destructive and fast, pump-probe technique measures the probe laser reflectance (DC reflectance) as well as the pump-laser-induced changes in probe reflectance (AC reflectance, also called TW signal). Interestingly, this technique uses tightly focused laser beams (radius=0.5 µm) allowing for very local measurements.

The physical origin of the commonly used signal, the AC reflectance, lies both in the pump-induced heating (*thermal* component) and in the presence of pump-generated excess carriers (*plasma* component), leading to two different and complementary measurement regimes and therefore two types of applications. On the one hand, if the *thermal* component is dominant (e.g. as-implanted layers, preamorphized substrates,...), the AC reflectance is a measure of the sample damage and, consequently, of implant dose[1,2]. On the other hand, if the *plasma* component is dominant (e.g. annealed implanted layers), the AC reflectance is sensitive to the carrier profile[3,4,5].

In this paper, we report on the latest advances in the use of TP for the monitoring of Ultra-Shallow Junctions both before and after annealing of the implanted layers. First, we discuss the sensitivity of TP to implant dose prior to anneal. Second, after annealing, we look at the capabilities of TP to map, over a whole wafer area, the local variations in sheet resistance (using the DC reflectance) simultaneously with the variations in junction depth (using the AC reflectance). Finally, we show that, by combining the DC and AC reflectances, TP offers a very powerful carrier profiling potential.

REFERENCES

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