Application Note

QUANTUM DIAMONDS
SENSOR TECHNOLOGY

Non-Destructive Short Failure Localization Through Wide Topside Metal with Quantum Diamond Microscopy

Many commercial integrated circuits with wide front-side metallization experience recurring short failures that consistently reduce yield. Conventional metal short localization techniques, such as OBIRCH face fundamental limitations in these devices when done from topside, as the signal is strongly attenuated. Moreover, for backside navigation, OBIRCH must work with IR imaging. To achieve this, OBIRCH analysis often requires backside silicon thinning to achieve a clear overlay. This preparation step introduces significant sample fragility, frequently leading to cracked or unusable dice before actionable root-cause data is obtained. Even when successful, OBIRCH can produce false-positives, driving time-consuming SEM that reveal no corresponding physical defect.

The QDM enables front-side, non-destructive magnetic imaging to localize current paths associated with short defects without any backside thinning. QDM identifies the correct short locations found by OBIRCH- and additional defects OBIRCH misses. Through this, QDM eliminates false positives, finds more insights, and protects device integrity for physical analysis- contributing directly to yield enhancement.

Case Study

The device under test (DUT) represents a class of commercially manufactured ICs with wide topside metallization. These devices commonly integrate several metal layers, inter-layer dielectrics, and passivation, which makes optical access to underlying structures increasingly difficult during failure analysis. During this case study, multiple samples of the same type were measured. Here, we showcase abstracted results from one selected.

OBIRCH vs. QDM

Previous failure analysis on this DUT class relied solely on OBIRCH to localize suspected short sites. However, due to the wide topside metal, OBIRCH required extensive backside preparation to work with IR imaging. Multiple samples from the batch have exhibited OBIRCH signals, whereas subsequent FIB-SEM has not identified any physical defects. This, combined with the need to backside thin the device significantly, destroying many samples in the process, delayed root-cause learning and did not permit meaningful yield enhancement.

Subsequent QDM measurement, on the other hand, has correctly identified the failure locations when compared with a known-good die. In some instances, QDM and OBIRCH have agreed on candidate spots, with QDM going beyond and identifying ones that OBIRCH has missed. Moreover, QDM measurements required no backside thinning and were directly imaged through the frontside metallization.

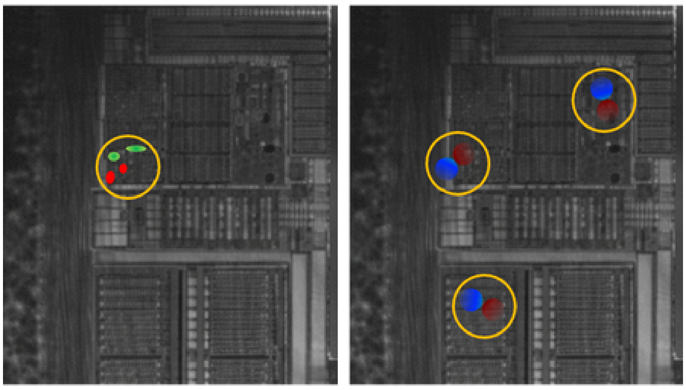

Figure 1: Left) Illustrative OBIRCH spot acquired from the thinned backside vs. **Right)** Illustrative QDM spots acquired directly from the frontside with no backside thinning requirement. Additionally, QDM found 3 failure spots instead of just 1 from OBIRCH.

This application note demonstrates QDM measurements using abstracted and anonymized data. All underlying measurements originate from commercial customer devices and are confidential. The data presented here illustrates QDM capabilities while preserving customer confidentiality.

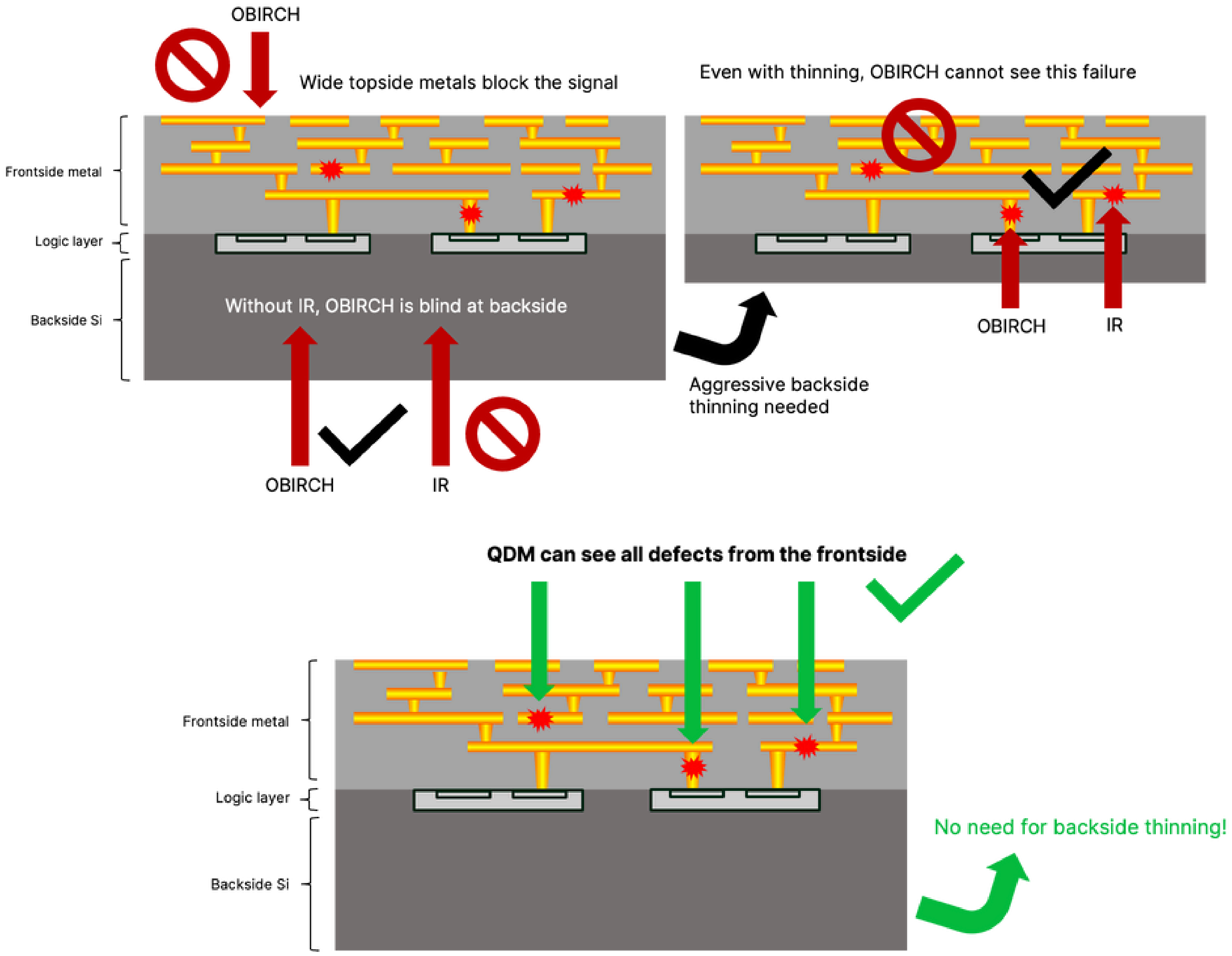

Figure 2: Illustration of OBIRCH and QDM for this device class. The cross-section is given with 4 metal layers at the frontside with a wide top metal, as well as thick Si at the backside, both blocking useful OBIRCH. The needed backside thinning is illustrated for IR-OBIRCH to be able to get a signal from the metal layers near the transistors. However, OBIRCH still cannot see metal lines beyond, which might contain defects. QDM requires no backside preparation and can find all defects through the metal layer.

QuantumDiamonds' **QDm.1** enables front-side, non-destructive localization through wide topside metal without dependence on backside IR transparency or destructive thinning. By directly imaging current paths associated with short defects, QDM removes ambiguity from localization and provides high-confidence targets for physical follow-up. For failure analysis teams, this translates into faster time-to-answer, fewer broken samples, and more productive FIB-SEM analysis, while preserving device integrity for correlation.

By replacing preparation-heavy workflows with direct current-path imaging, QDM accelerates root-cause learning and directly supports yield enhancement in devices with wide and dense front-side metallization.

To learn how the QuantumDiamonds' QDm.1 can accelerate your failure analysis workflow and improve yields, visit our website via the QR code or get in touch.

Interested in learning more?

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