

Impact of Si Wafer Nominal Resistivity on RF Harmonic Distortion

Introduction

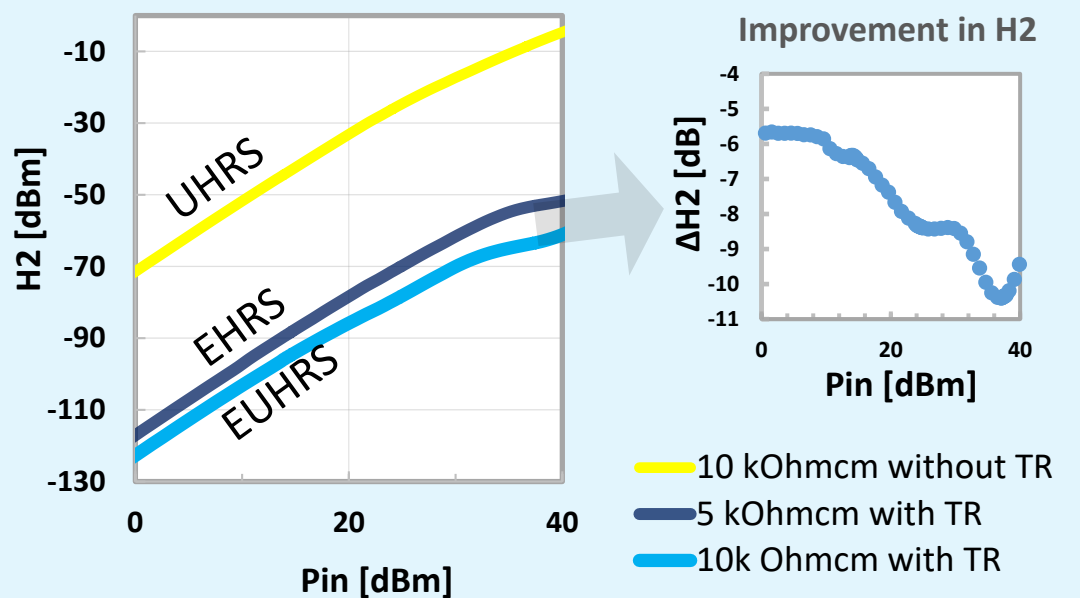
The nominal resistivity of a surface-passivated high resistivity silicon wafer has undoubtedly an effect on substrate-induced RF nonlinearity and harmonic distortion. Second harmonic (H2) levels are measured for Okmetic RFSi® wafers showing excellent results for Engineered Ultra High Resistivity EUHRS wafers.

Method

H2 levels were measured for different wafers with 50Ω coplanar waveguide (CPW) transmission line test structures of 2mm length, 12 μm S-to-G gap and 900 MHz fundamental tone.

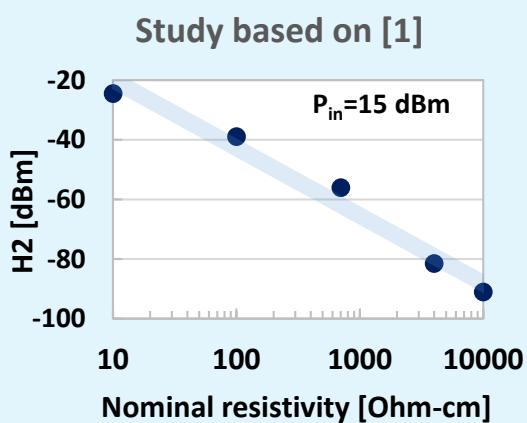
Results

Using Ultra-high resistivity 10 kOhm-cm wafer with TR (trap-rich layer) as opposed to 5 kOhmcm TR layer, **even 10 dB further improvement** in linearity can be achieved especially at high powers.



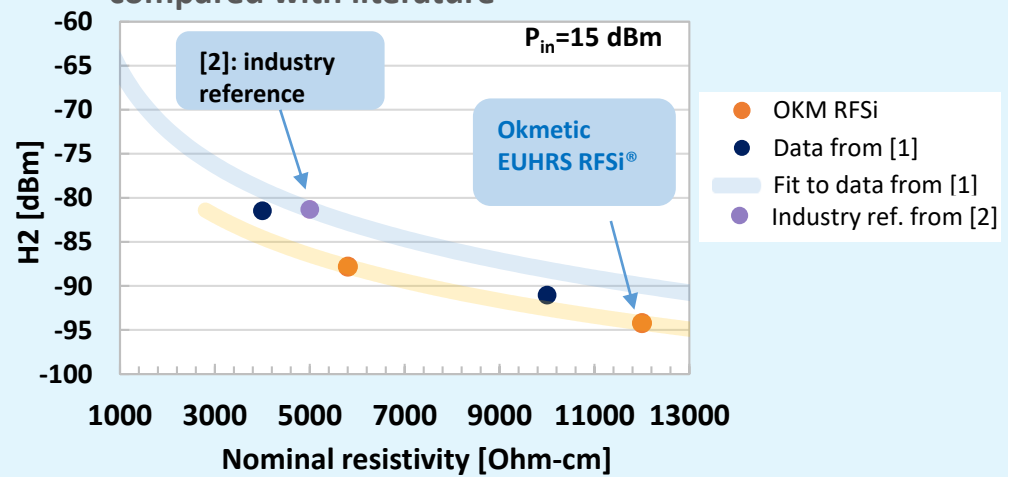
Comparisons with literature

HD from CPWs using trap-rich wafers with five different nominal resistivities has been studied before in [1]. We further showed that H2 level



displays a simple relation with wafer nominal resistivity (left figure). When compared using the same CPW characterization, Okmetic RFSi® wafers with trap-rich layer result very predictable linearity performance (right figure). EUHRS wafer demonstrates even lower losses and **optimal RF linearity**.

Okmetic Engineered Ultra High Resistivity wafer compared with literature



Conclusions

Okmetic RFSi® wafers are released for RF devices with the **most demanding linearity requirements**. 5 to 10 dB further H2 suppression can be achieved with Engineered Ultra High Resistivity wafer.

References

- [1] Neve, Cesar Roda, and Jean-Pierre Raskin. "RF harmonic distortion of CPW lines on HR-Si and trap-rich HR-Si substrates." *IEEE Transactions on Electron Devices* 59.4 (2012): 924-932
- [2] Rack, Martin, Frédéric Allibert, and J-P. Raskin. "Modeling of Semiconductor Substrates for RF Applications: Part II—Parameter Impact on Harmonic Distortion." *IEEE Transactions on Electron Devices* 68.9 (2021): 4606-4613

RF measurements on Okmetic wafers were conducted by Incize.