

## Impact of Si Wafer Nominal Resistivity on RF Harmonic Distortion

### Introduction

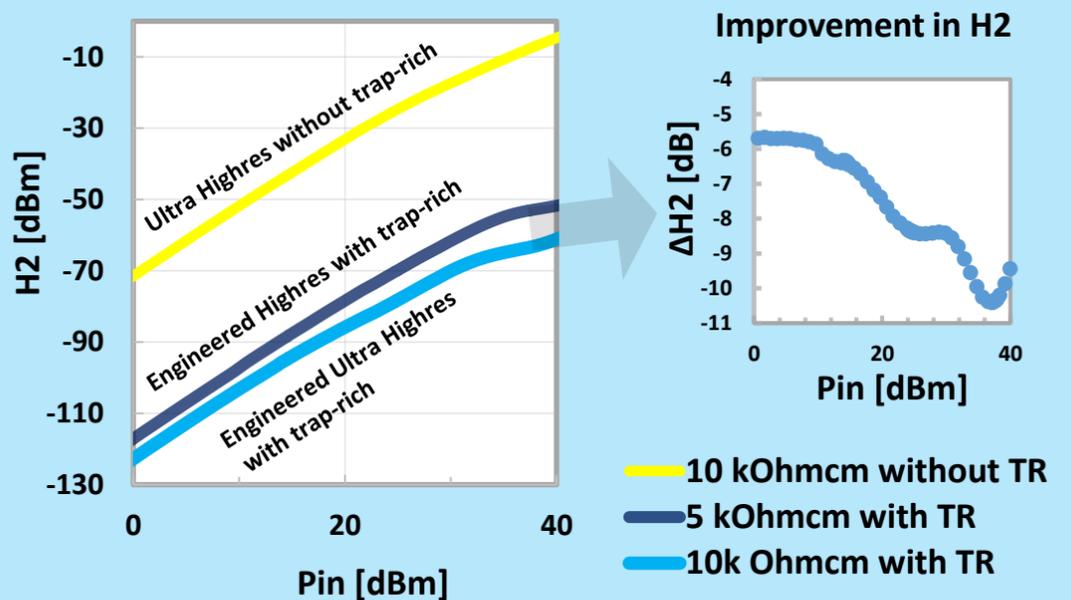
The nominal resistivity of a surface-passivated high resistivity silicon wafer has undoubtedly an effect on substrate-induced RF nonlinearity and harmonic distortion. Second harmonic (H2) levels are measured for Okmetic RFSi® wafers showing excellent results for Engineered Ultra High Resistivity wafers.

### 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.

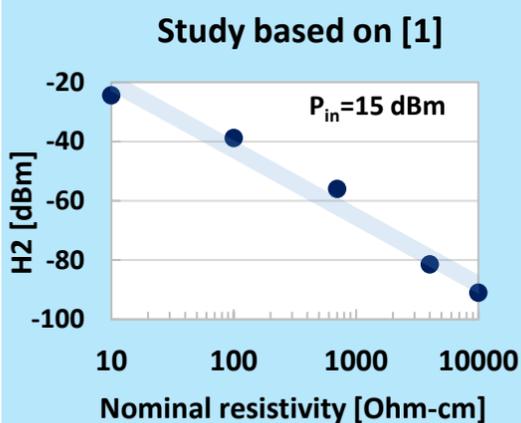
### Results

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



### Comparisons with literature

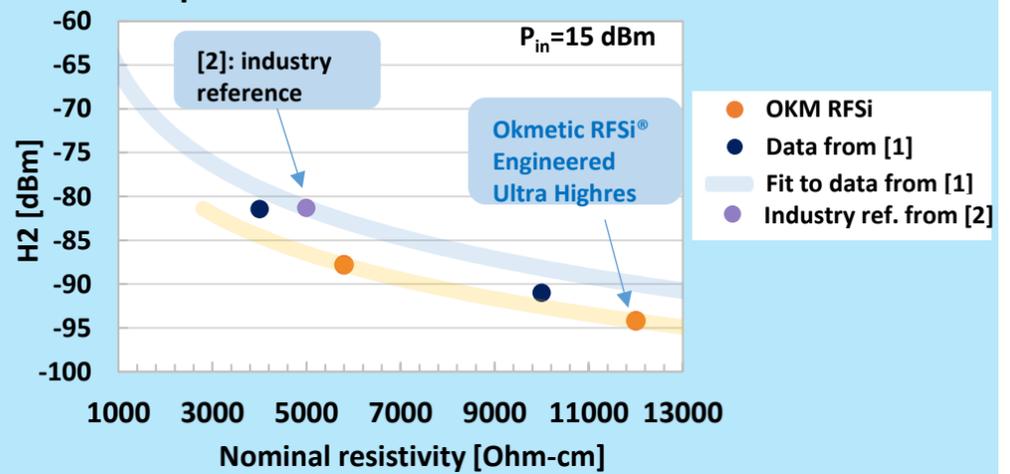
HD from CPWs using trap-rich wafers with five different nominal resistivities has been studied before in [1]. We further showed that H2 level



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.

