

Improved Missing Pattern Defects using Megasonic for Hard Mask Clean at 14 nm and Beyond

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Abstract

Scaling challenges in BEOL technology for 14nm and beyond makes lithography patterning extremely sensitive to particles generated at TiN deposition steps. These particles translate into missing pattern defects classified as multiple line opens (MLO) and single line opens (SLO). High MLOs and SLOs are one of the highest device yield detractors in BEOL technology. Here we report improved HM cleaning with reduced MLOs and SLOs by adding Megasonic irradiation to conventional POR (process of record) cleaning recipe

Challenges

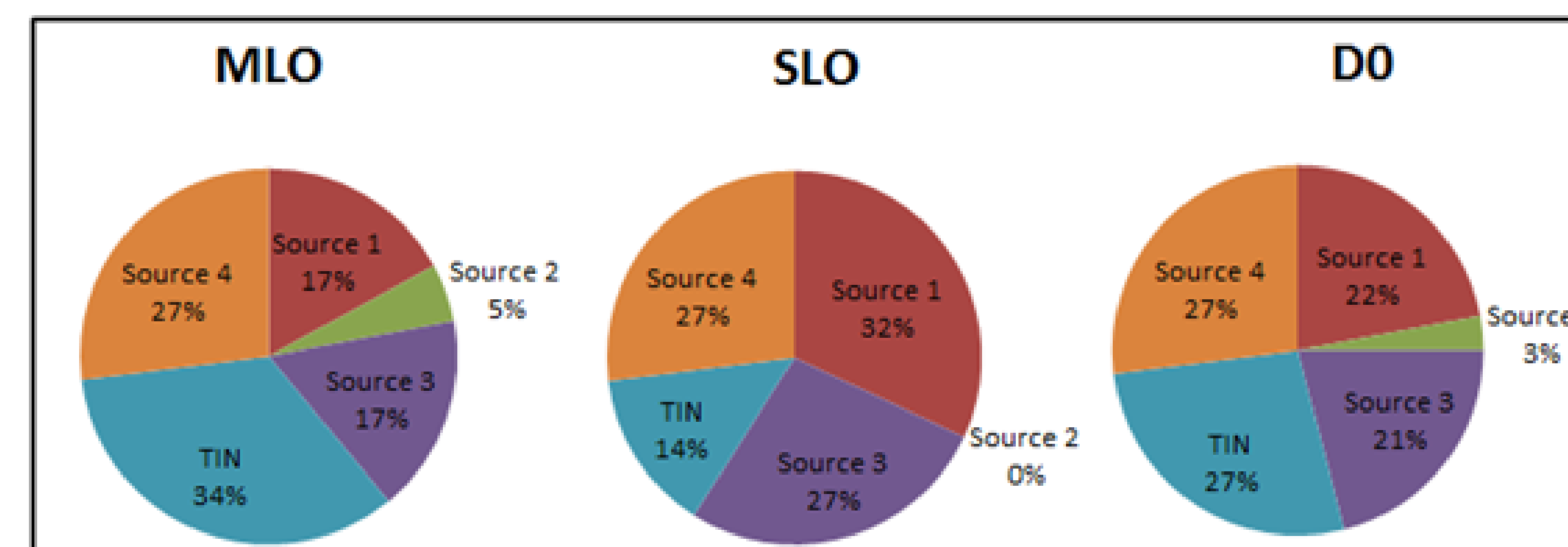


Fig above shows various sources that contributes to MLO SLO. ~27 % of the total defects (D0 = MLO + SLO #/cm2) are introduced during HM/TiN deposition steps

Defect Translation

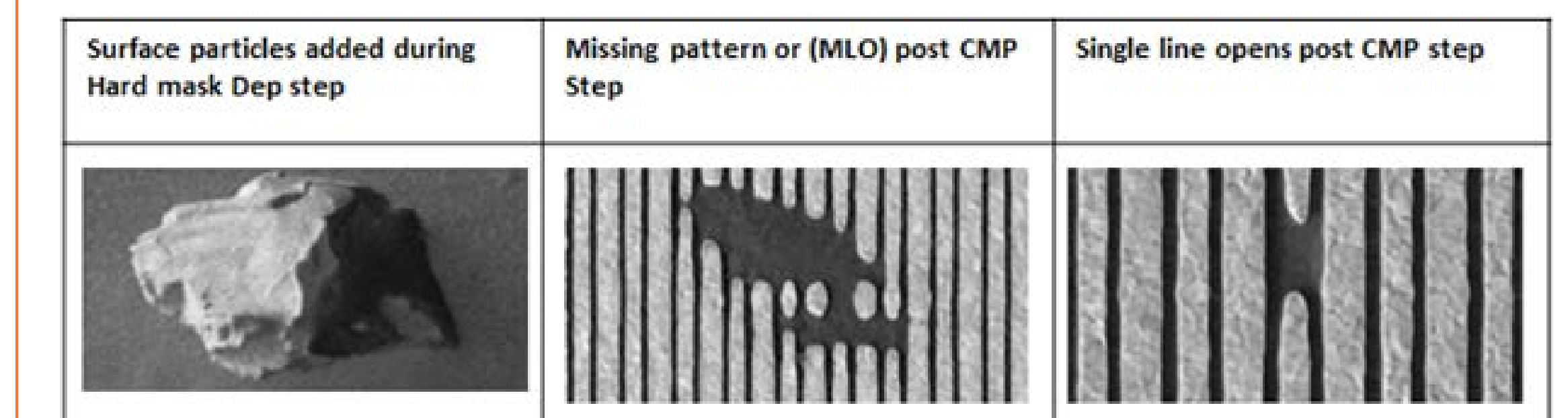


Fig. above shows translation of defects added during hard mask deposition into downstream missing pattern defects (MLO and SLO) post copper CMP (Chemical Mechanical Planarization). Line opens lead to electrical contact resistance fails and consequent die yield degradation.

Results

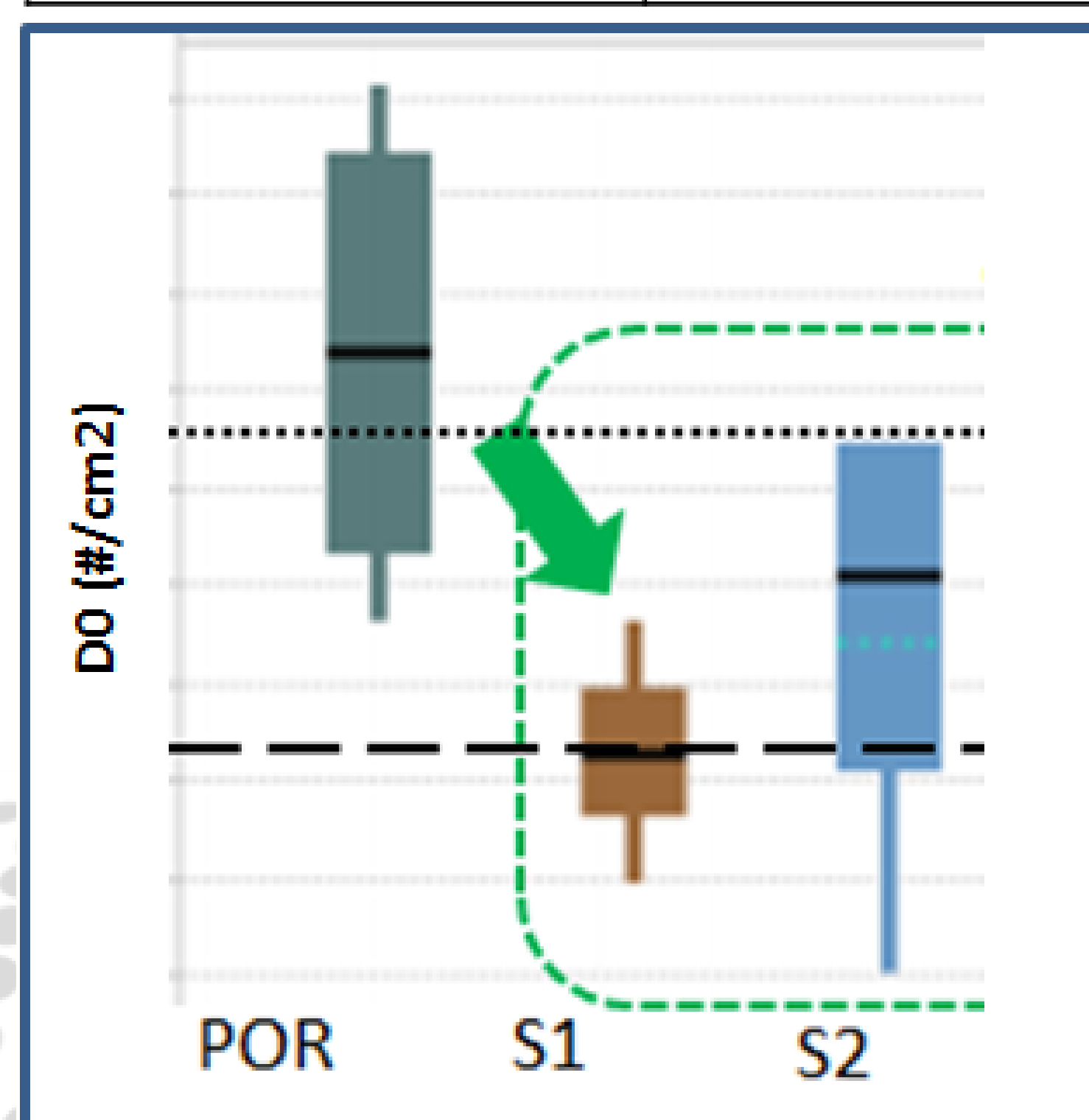
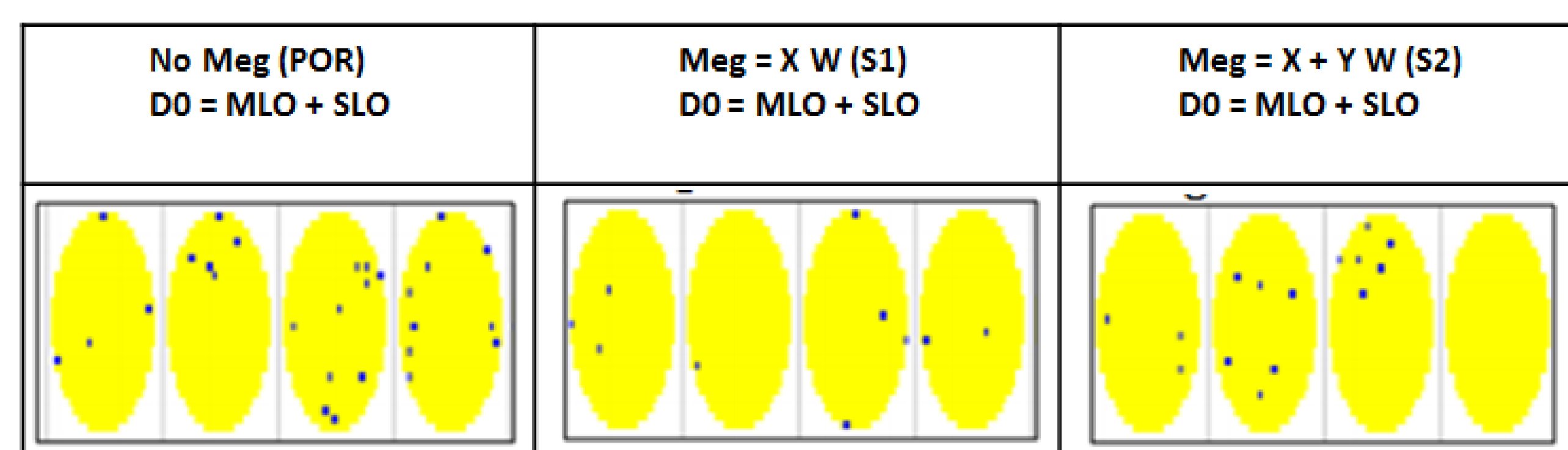


Fig shows Megasonic addition to POR recipe (S1), leads to ~ 65% total defect (D0) improvement

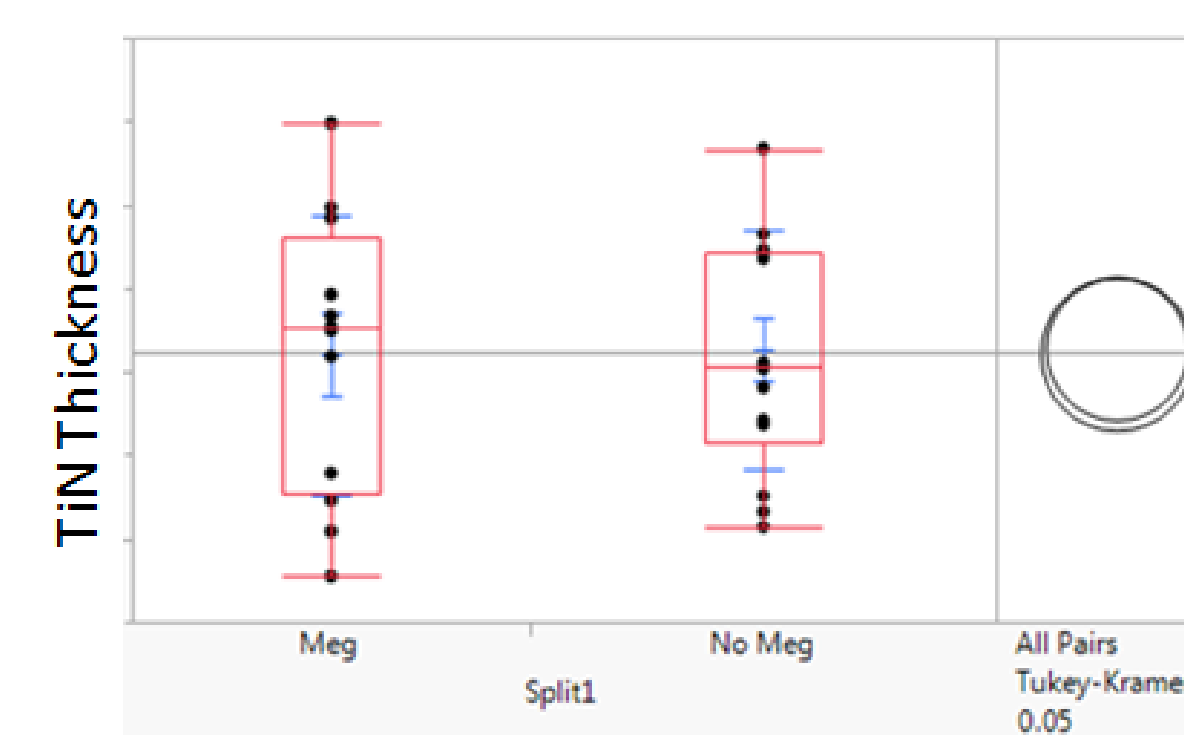


Fig above shows TiN thickness remains unchanged when Megasonic added

Summary

1. Litho patterning extremely sensitive to TiN dep clean steps for 14 nm and beyond Technology
2. ~ 27% of total defects (D0 = MLO + SLO #/cm2) are introduced during TiN deposition steps
3. Defects during TiN dep steps translate to single line and multiple line opens post CMP
4. Addition of Megasonics to conventional POR recipe improved baseline D0 performance by ~65 % with no change to inline TiN thickness.

References

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