

Die-First FOPLP Lithography Challenges Due To Die Shifting And A Solution Using Feedforward Adaptive Shot Technology

John Chang, Jian Lu, Timothy Chang, Keith Best

Onto Innovation
Wilmington, MA, USA

Onto Innovation

High tech capital equipment company specializing in optical process solutions for semiconductor and related markets



FOUNDED **2019**



1,500 EMPLOYEES



>9,000 ACTIVE METROLOGY & INSPECTION
TOOLS INSTALLED



>80 Fabs FAB-WIDE YIELD/DEFECT
SOFTWARE INSTALLED

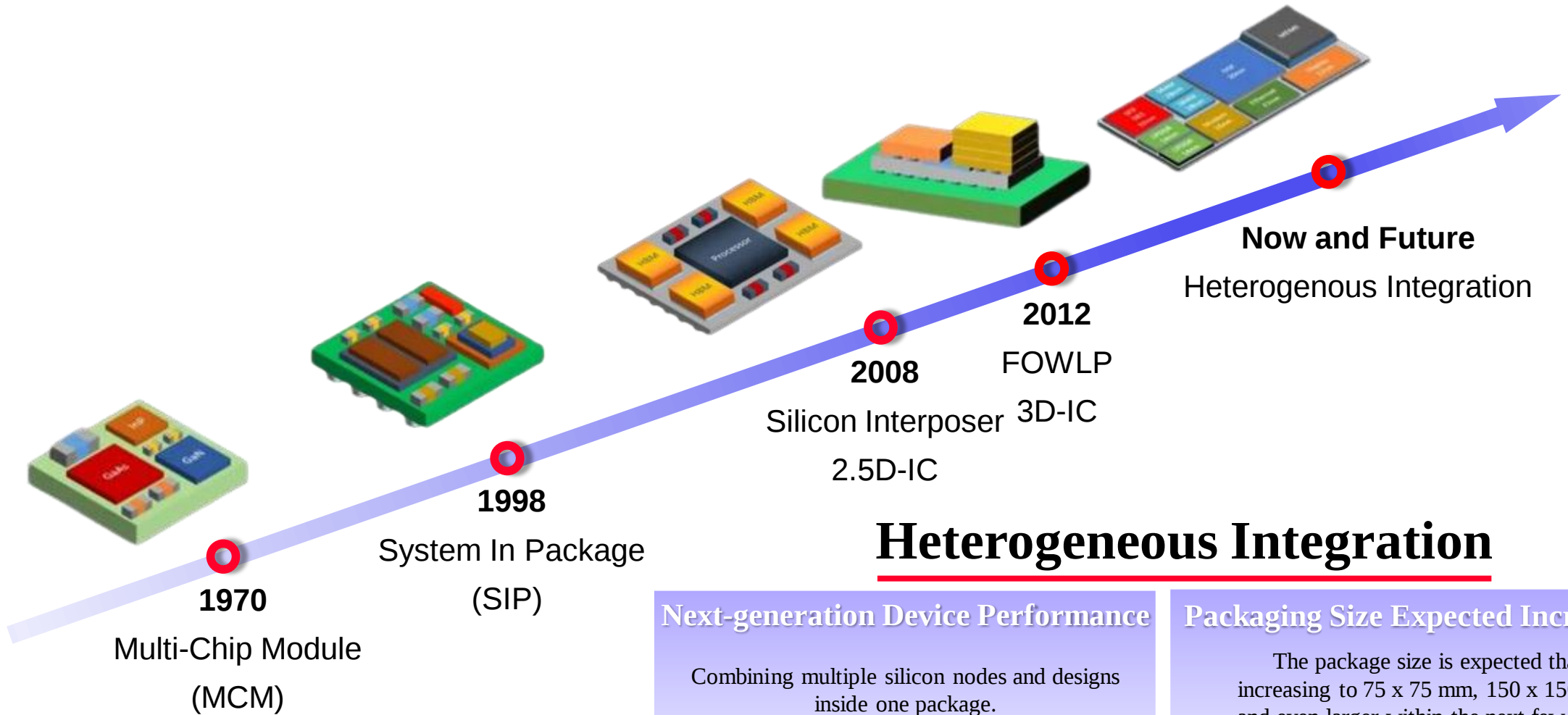


\$816M 2023 REVENUE



- Introduction
- Die-First FOPLP Lithography Challenge
- Trade-off Between Yield and Throughput
- Adaptive Shot Technology and Feedforward Technology
- Demonstration and Results Review
- Summary and Conclusion

Heterogeneous Integration



Heterogeneous Integration

Next-generation Device Performance

Combining multiple silicon nodes and designs inside one package.

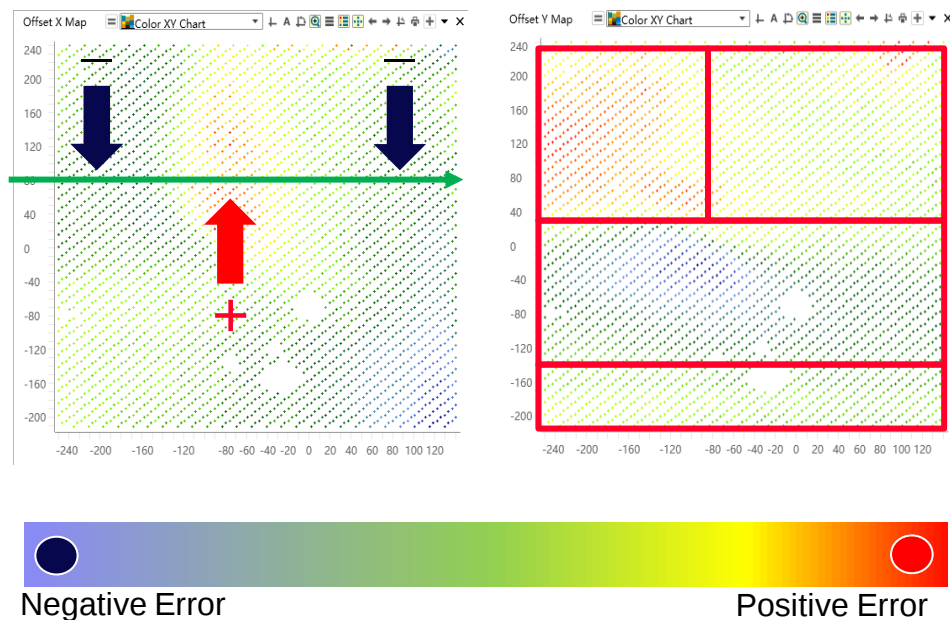
Packaging Size Expected Increasing

The package size is expected that increasing to 75 x 75 mm, 150 x 150 mm and even larger within the next few years

Trade-Off Between Yield and Throughput in FOPLP Lithography

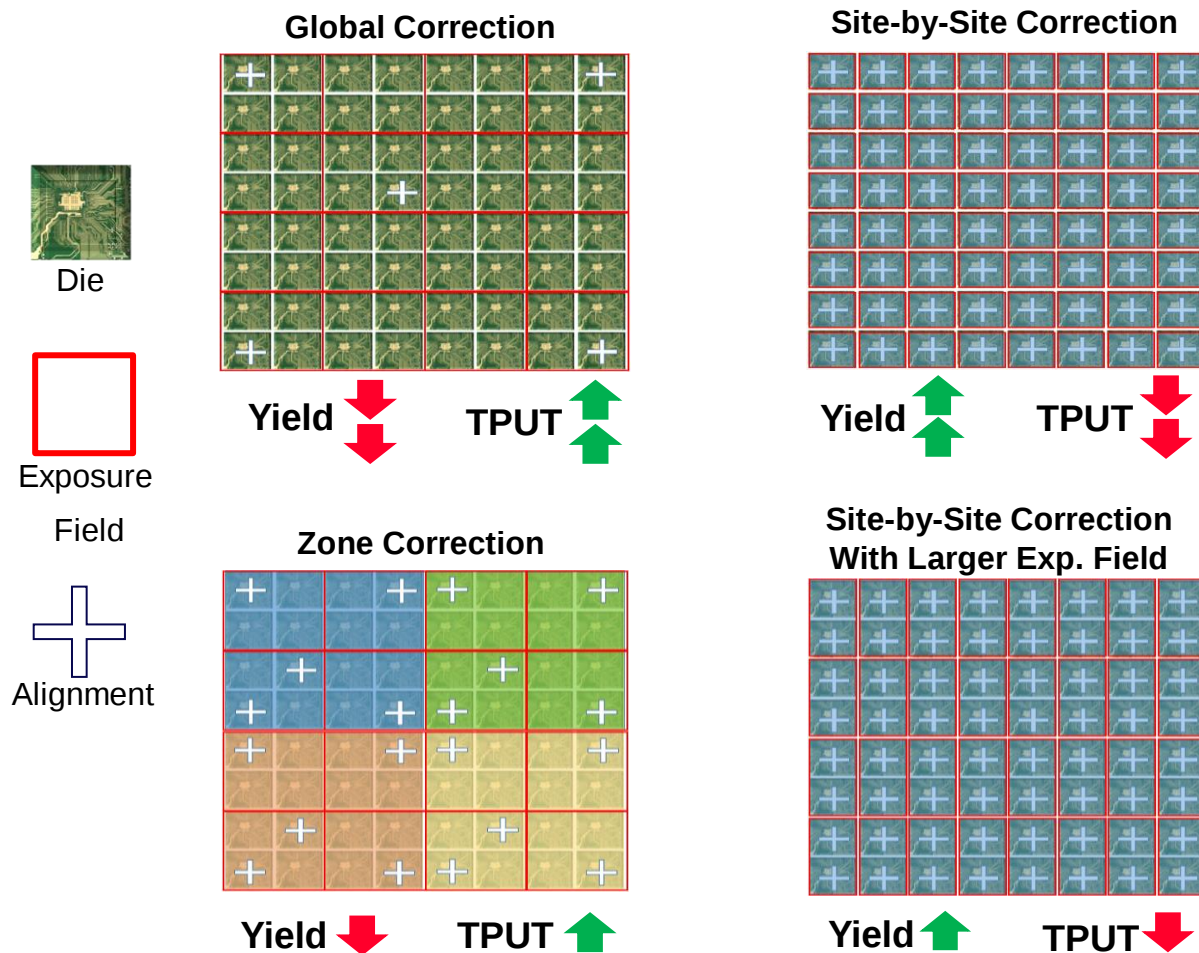
IMAPS 20th Device Packaging Conference | March 18-21, 2024 | Fountain Hills, Arizona

FOPLP Die Error Distribution Analysis



Single Correction cannot address the non-linear error in substrate

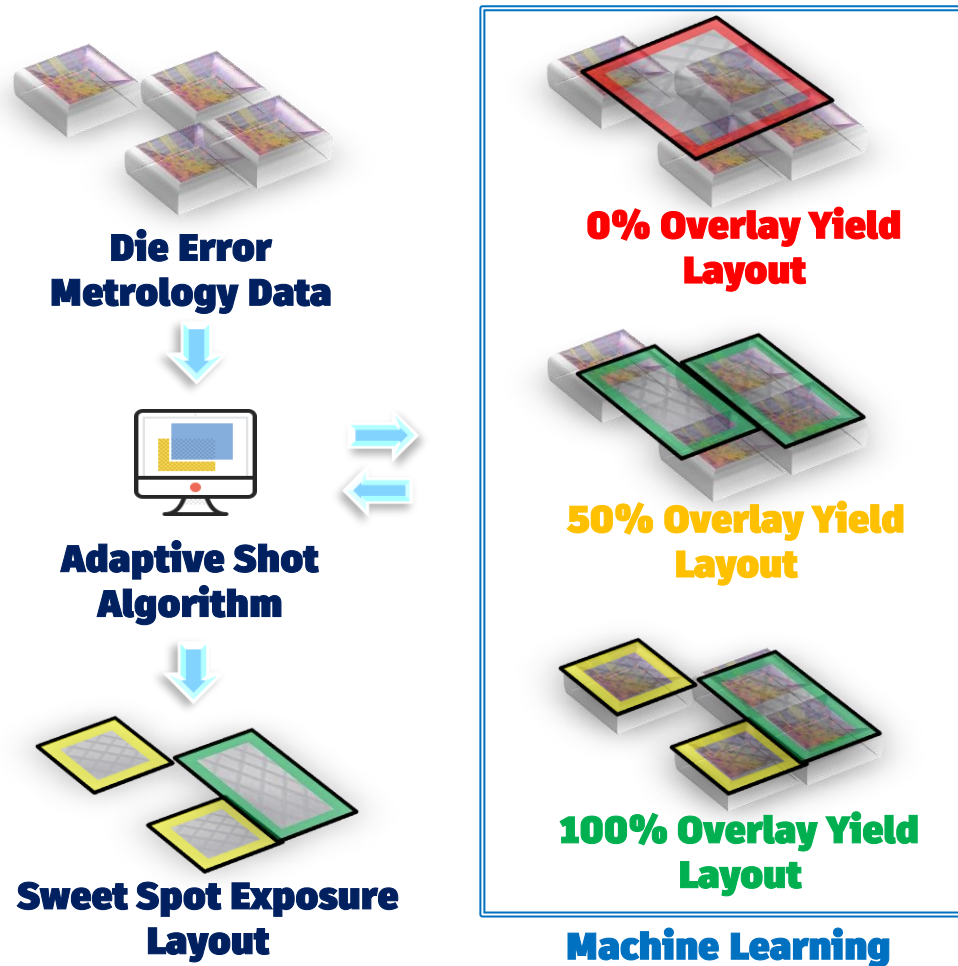
Current Lithography Correction Methods To Address Die Error



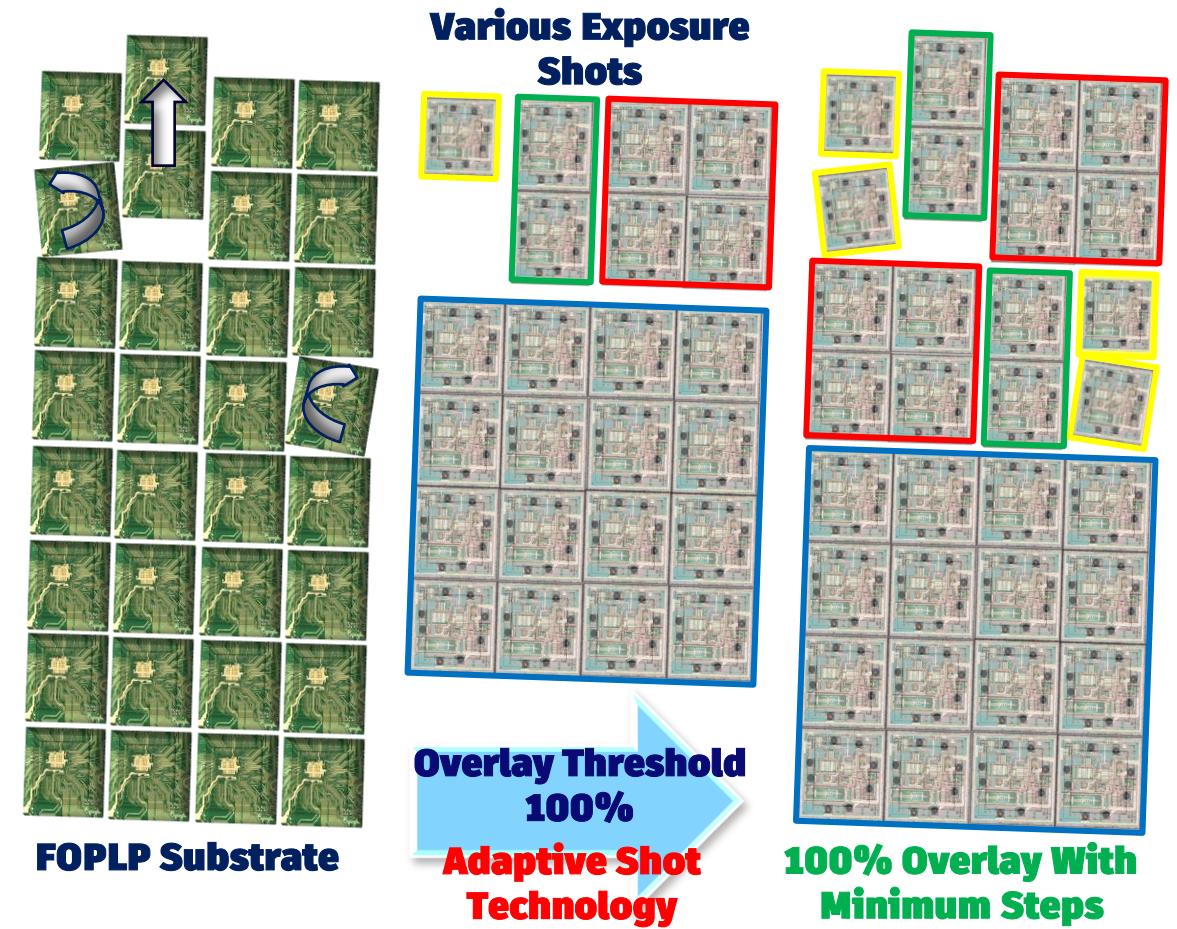
- Introduction
- Die-First FOPLP Lithography Challenge
- Trade-off Between Yield and Throughput
- **Adaptive Shot Technology and Feedforward Technology**
- Demonstration and Results Review
- Summary and Conclusion

Adaptive Shot Technology

Adaptive Shot Technology Working Scenario



An Example with Applying Adaptive Shot Technology



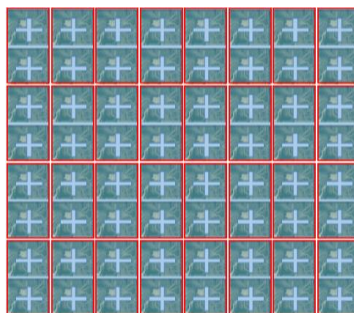
Feedforward Technology to Boost Lithography Throughput

IMAPS 20th Device Packaging Conference | March 18-21, 2024 | Fountain Hills, Arizona

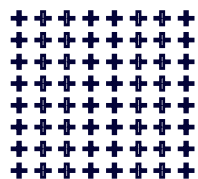
3 Steps to Achieve Adaptive Shot Exposure



Stepper

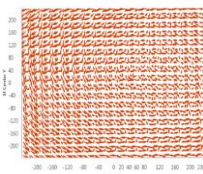


Adaptive Shot Exposure



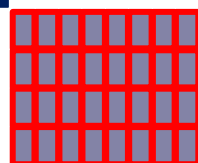
Metrology

Die location and error recognition



Analysis

To determine the sweet spot layout and corrections to correct the die errors



Exposure

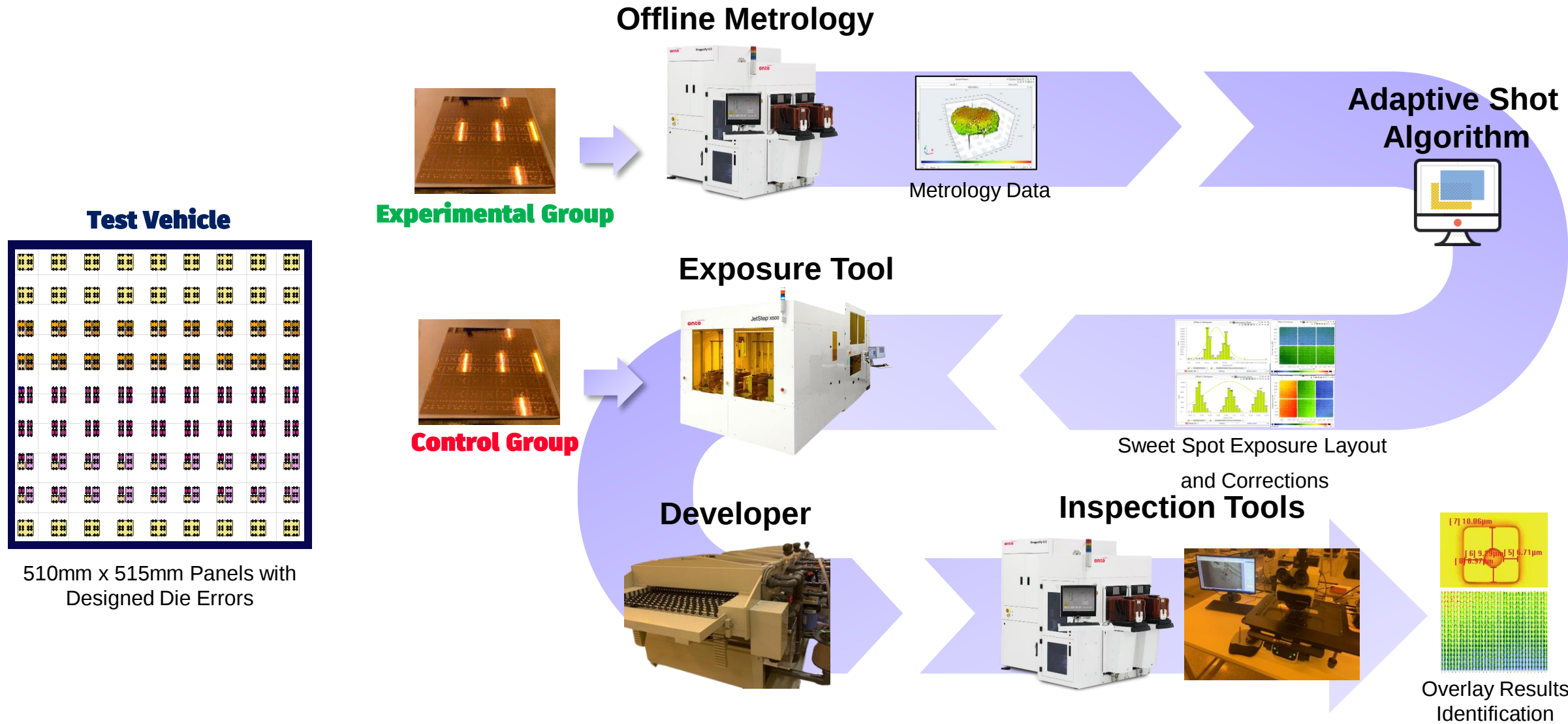
To expose the substrate with specific layout and corrections

Feedforward Adaptive Shot Technology To Boost Lithography TPUT



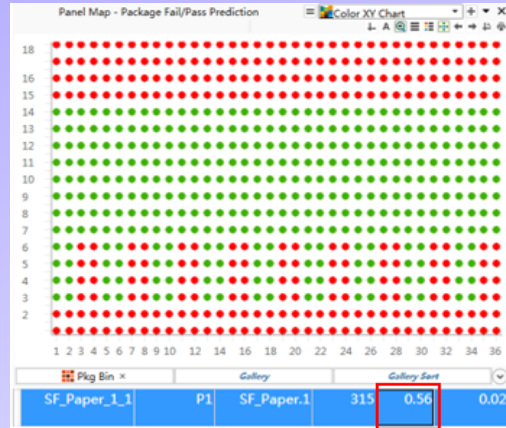
- Introduction
- Die-First FOPLP Lithography Challenge
- Trade-off Between Yield and Throughput
- Adaptive Shot Technology and Feedforward Technology
- **Demonstration and Results Review**
- Summary and Conclusion

Demonstration Method



Demonstration Results and Reviewing

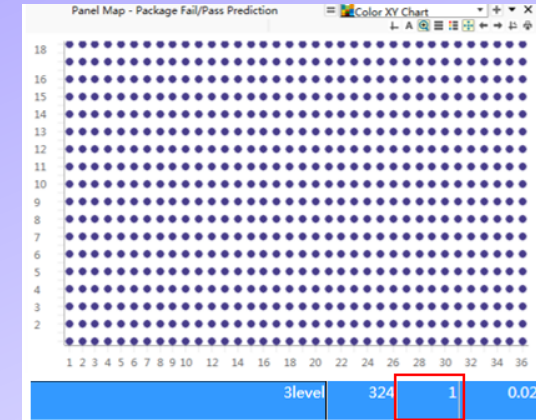
Control Group



Overlay Results MAP : 56% Yield

● Die within overlay threshold ● Die out of overlay threshold

Experimental Group



Overlay Results MAP : 100% Yield

● Die within overlay threshold

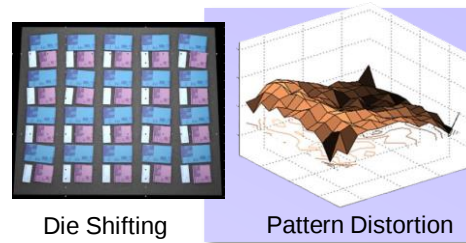
Adaptive Shot Technology

- ✓ Address various die error correctly
- ✓ Automatically identify sweet spot
- ✓ Feedforward to boost TPUT

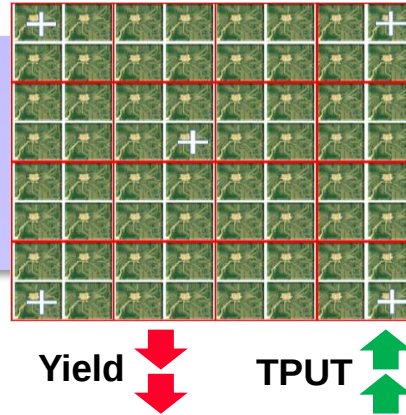
- Introduction
- Die-First FOPLP Lithography Challenge
- Trade-off Between Yield and Throughput
- Adaptive Shot Technology and Feedforward Technology
- Demonstration and Results Review
- **Summary and Conclusion**

Summary and Conclusion

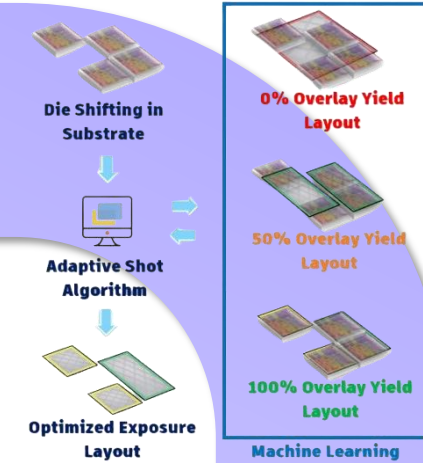
Non-linear Error in Die-First FOPLP Substrate



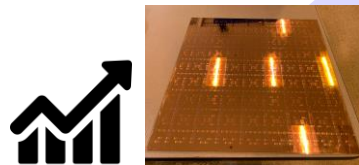
Trade-Off Between TPUT and Yield



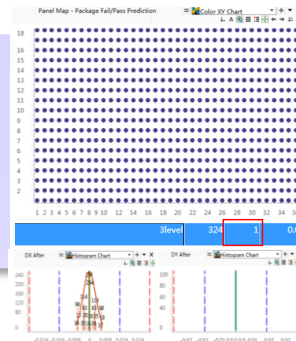
Adaptive Shot Technology



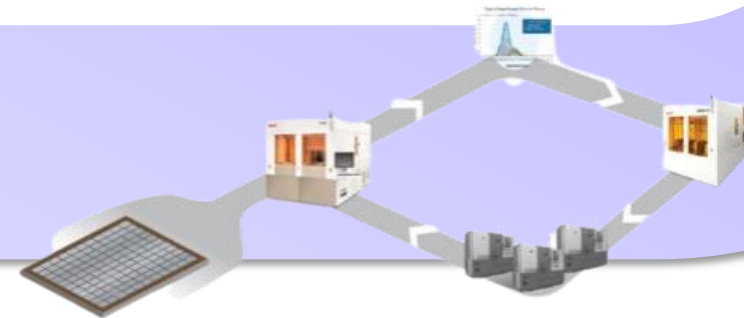
Path to Optimized Yield and TPUT Enhancement



Success to Demonstration



Feedforward Lithography





Thank You

谢谢 | 謝謝 ありがとう Obrigado

Danke 감사합니다 Merci

innovation®
onto

John Chang
John.Chang@ontoinnovation.com