EUV advanced profiling using scatterometry: sidewall roughness and bottom residue

Aron Cepler[1], Cornel Bozdog[1], Elad Arnon[1], Alok Vaid[2], Shay Wolfling[1]
[1] Nova Measuring Instruments, LTD. | [2] GLOBALFOUNDRIES, INC

MOTIVATION

EUVL produces higher density patterns. New challenges emerge: relative importance of sidewall roughness increases, and residue might be present after photoresist development.

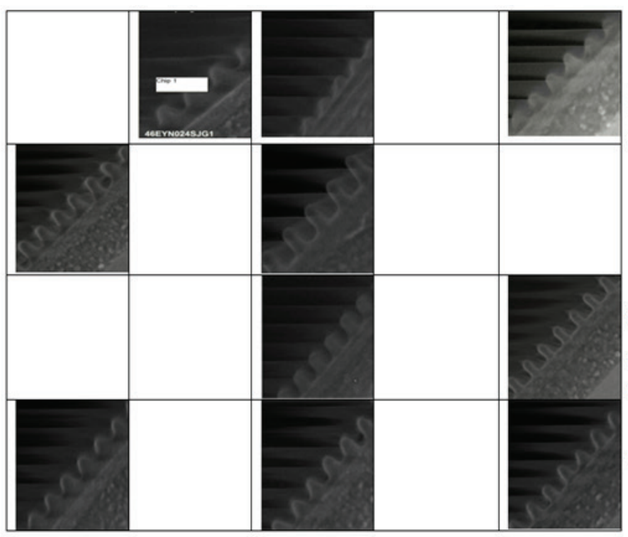
CHALLENGE

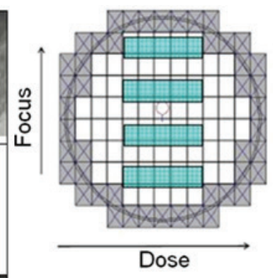
Scatterometry is the current workhorse toolset for in-line profile measurement. Can it still measure line profile? What changes to traditional modeling are needed?

METHOD

Develop and compare different scatterometry models to partial reference (CD-SEM) and to destructive reference (X-SEM). Identify the model and analysis methods suitable for EUVL challenges.

X-SEM



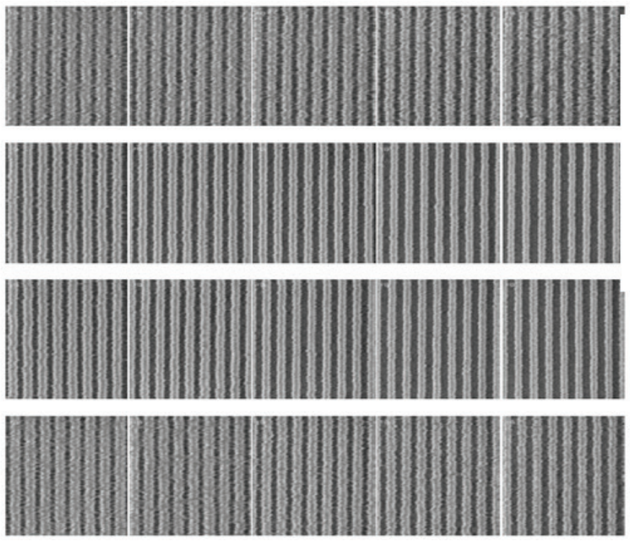


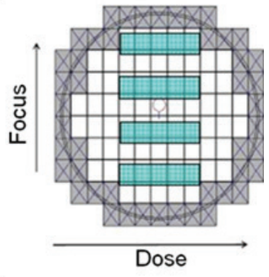
Residue, taper, shrinkage

Most stable parameter against e-beam shrink: SWA

We use SWA as reference

CD-SEM

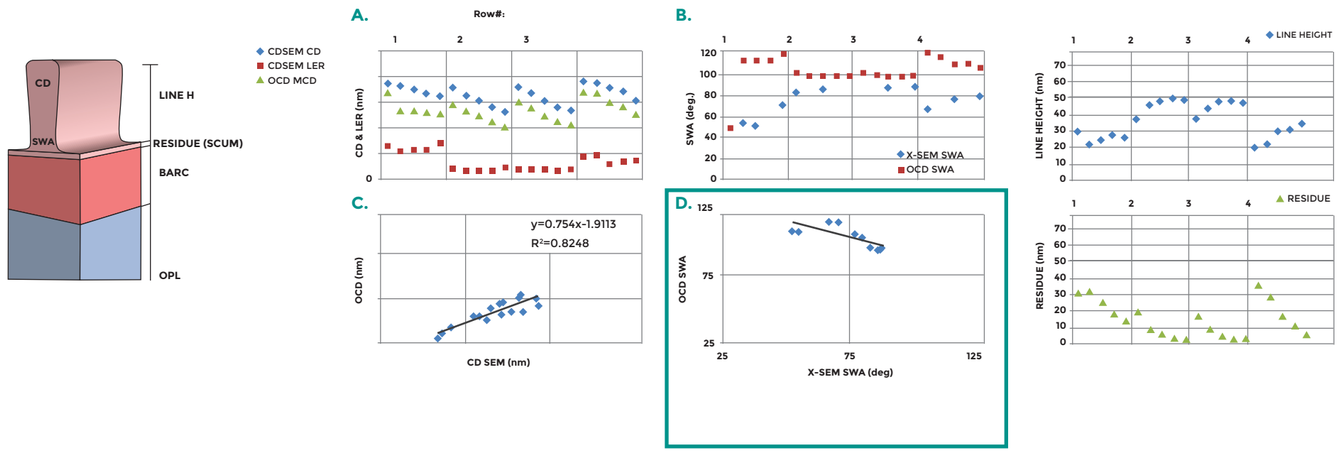




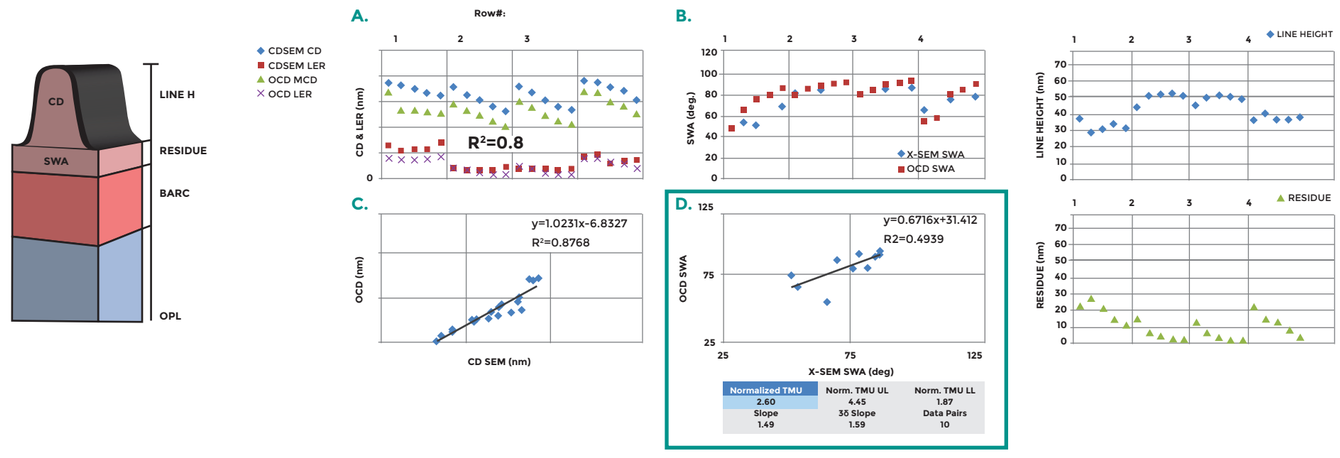
CDSEM measure CD & LER

We use them for OCD hybridization

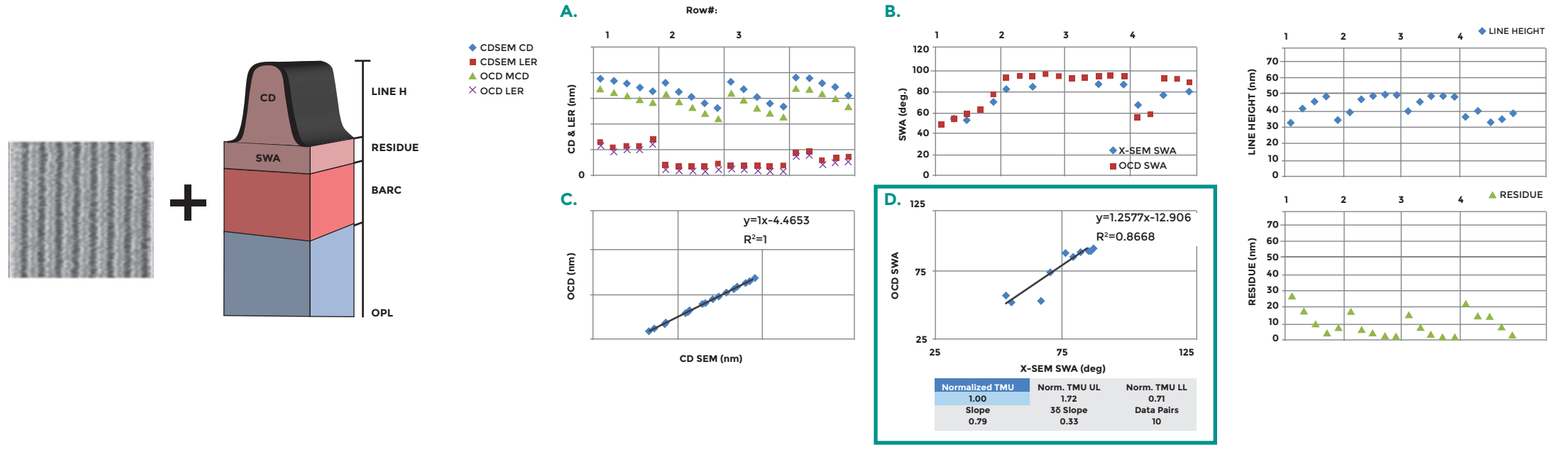
SCATTEROMETRY MODEL #1: STANDARD



SCATTEROMETRY MODEL #2: WITH LER



SCATTEROMETRY + CD-SEM: HYBRID METROLOGY



Results, discussion and summary:

X-SEM and scatterometry cross-validation

(both cannot be wrong in the same way).

LER modeling is critical:

scatterometry fails to measure profile unless LER is considered

Hybrid using CD-SEM CD and LER helps extract the fine profile details.