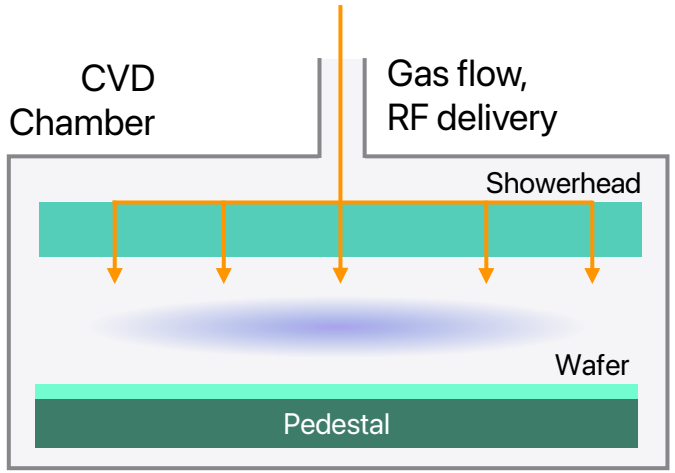
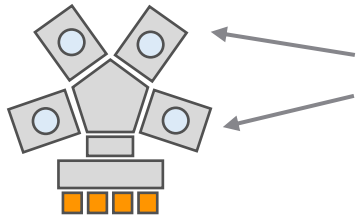
Example 1: identifying source of hardware variation affecting process

Problem statement:

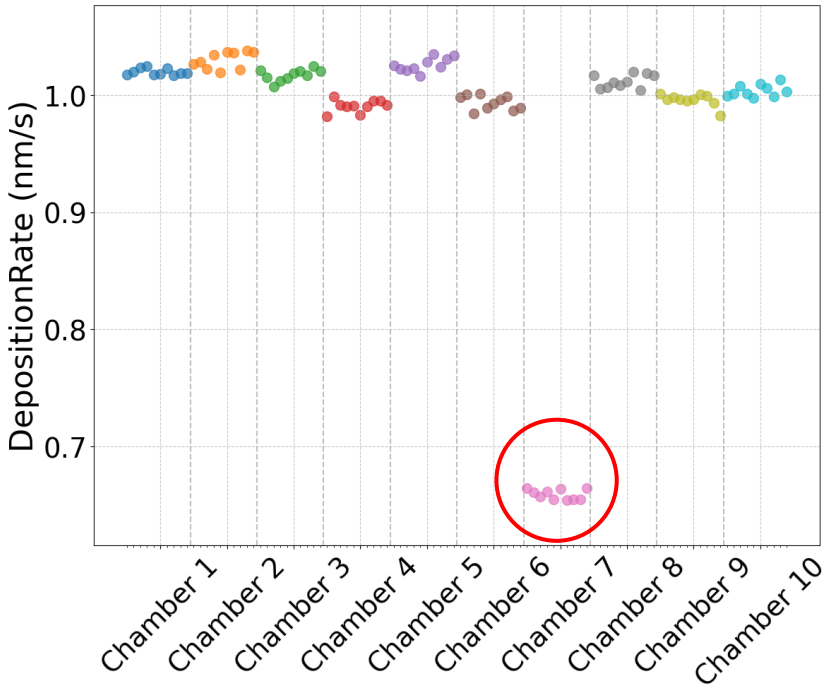
- We are targeting 1 nm / min deposition rate of a plasma enhanced SiO_2 deposition
- One chamber consistently has a lower growth rate
- We want to understand the source of this variation

Chamber parameter	Setpoint
Chamber pressure	100 Torr
Gas 1 flowrate (SiH_4)	200 sccm
Gas 2 flowrate (O_2)	100 sccm
Showerhead temperature	400 °C
Pedestal temperature	390 °C
Chamber wall temperature	380 °C
Carrier gas flowrate (Ar)	1000 sccm
Plasma power	1000 W





Multiple process chambers on a platform



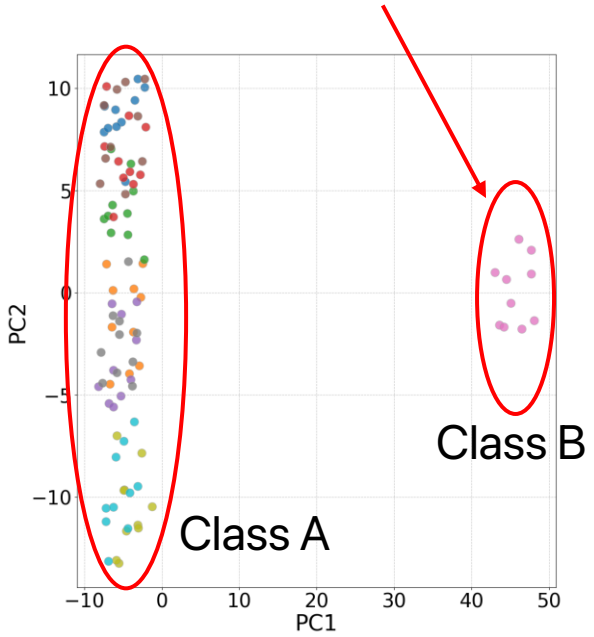
Example 1: identifying source of hardware deviation affecting process

Chamber sensor data collected during the process

Sensor data
Chamber pressure
Gas 1 flowrate (SiH_4)
Gas 2 flowrate (O_2)
Showerhead temperature
Pedestal temperature
Chamber wall temperature
Carrier gas flowrate (Ar)
Plasma power

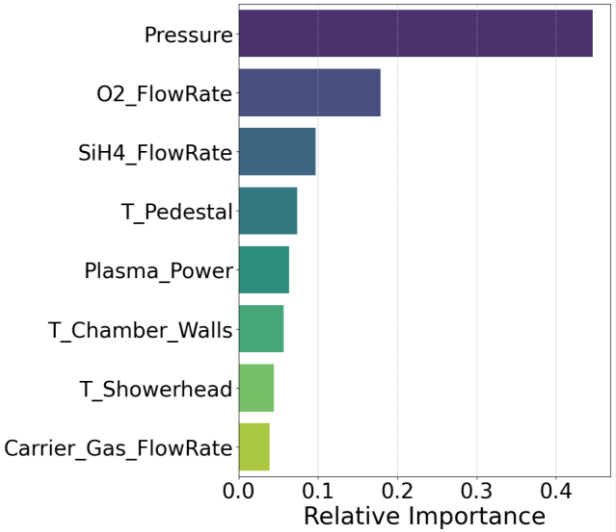
Principal component analysis

Wafers from outlier chamber



Classification analysis using random forest tree model

Top contributing sources of variation



Link to notebook with the simulated chamber and PCA model:
https://www.kaggle.com/code/adrianacosta0/data-science-for-semiconductor-process-reliability