

Deployment in Chemical Vapor Deposition Applications¹

Table 1: Chemical Vapor Deposition Target

Target Type	MFL (Ours)	Target Constraints
Film thickness (center) [nm]	1047.5	(100, 2000)
Film thickness (edge) [nm]	1147.3	(100, 2200)
Internal stress [MPa]	0.047	(-500, 500)
Surface roughness (Ra) [nm]	5.148	(0.1, 10)

Table 2: Chemical Vapor Deposition Input

Input Type	MFL (Ours)	Input Constraints
SiH ₄ flow rate [sccm]	317.0320	(50, 500)
NH ₃ flow rate [sccm]	560.5539	(100, 1000)
N ₂ flow rate [sccm]	1288.5685	(200, 2000)
Chamber temperature [°C]	541.5430	(300, 750)
Chamber pressure [Torr]	5.1651	(1, 10)
Chamber humidity [%RH]	24.6166	(5, 40)
Electrode distance [mm]	16.7863	(10, 30)
Pre-clean plasma power [W]	146.6214	(0, 300)
Pre-clean duration [s]	36.2421	(0, 60)
Wafer rotation speed [rpm]	1906.4441	(0, 3000)
Process time [s]	5.05	144.5516

Deployment in Wire Bonding Applications²

Table 3: Wire Bonding Target

Target Type	MFL (Ours)	Target Constraints
Pull strength [gf]	15.005	(5, 25)
Bonding x-offset [μm]	-0.0001	(-20, 20)
Bonding y-offset [μm]	-0.0002	(-20, 20)

Table 4: Table 4: Wire Bonding Input

Input Type	MFL (Ours)	Input Constraints
Bonding pressure [gf]	98.6096	(20, 120)
Bonding time [ms]	19.9200	(1, 30)
Temperature [°C]	240.9897	(100, 300)
Wire diameter [μm]	28.0635	(15, 33)
Wire length [mm]	3.2536	(0.5, 5.0)
Pad diameter [μm]	88.7107	(50, 150)

The applications in chemical vapor deposition and wire bonding are beyond the semiconductor recipe generation, these results highlight the generality and adaptability of our method across diverse tasks in different domains. We believe this extension demonstrates the broader applicability of our method.

Ablation Experiments

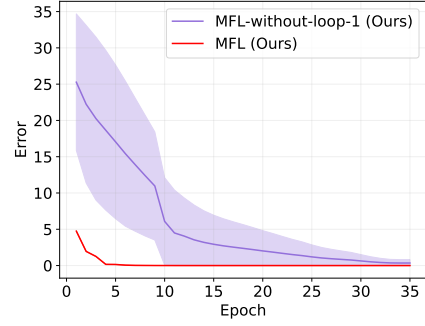


Figure 1: Ablation experiments: comparison between MFL and MFL without loop 1 training.

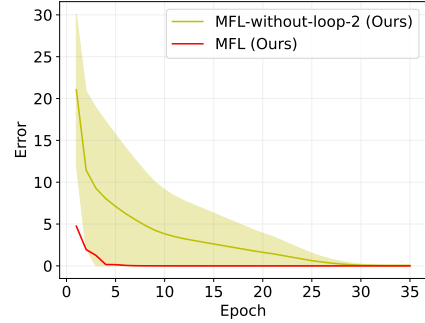


Figure 2: Ablation experiments: comparison between MFL and MFL without loop 2 training.

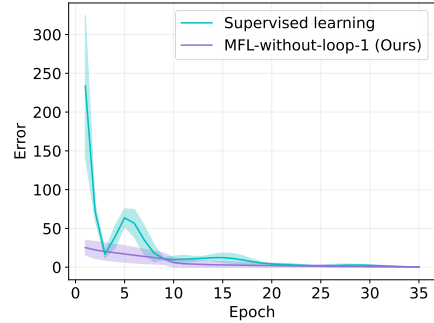


Figure 3: Ablation experiments: comparison between MFL without loop 1 training and supervised learning.

¹https://en.wikipedia.org/wiki/Chemical_vapor_deposition

²https://en.wikipedia.org/wiki/Wire_bonding