



Low temperature ALD-Grown Superconducting Tunnel Contacts

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Motivation and Outline



Superconductor + Tunnel Barrier + 2DES:

- Density of states mapping
- Correct work function mismatch

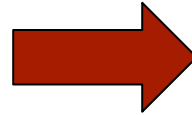
Superconductor
Dielectric
Exotic 2DES



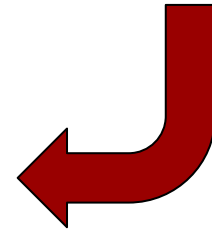
← Fragile materials



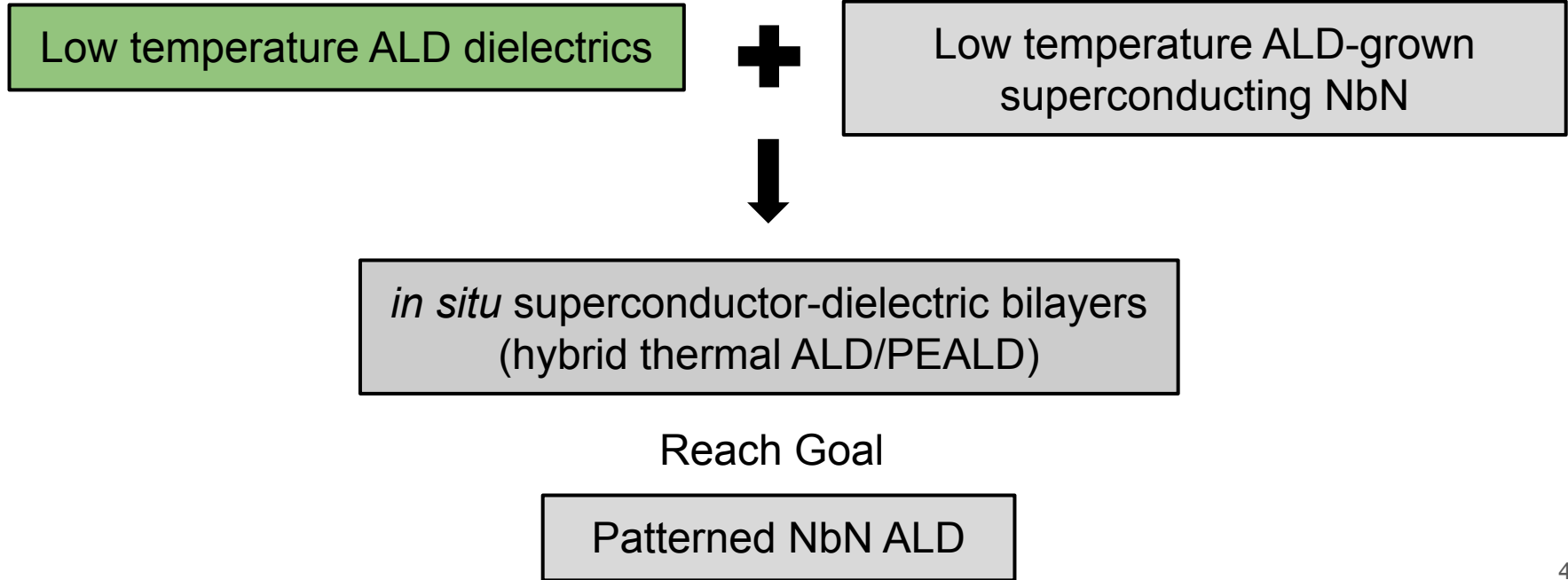
Motivation and Outline



Normal Metal
Superconductor
Dielectric
Exotic 2DES

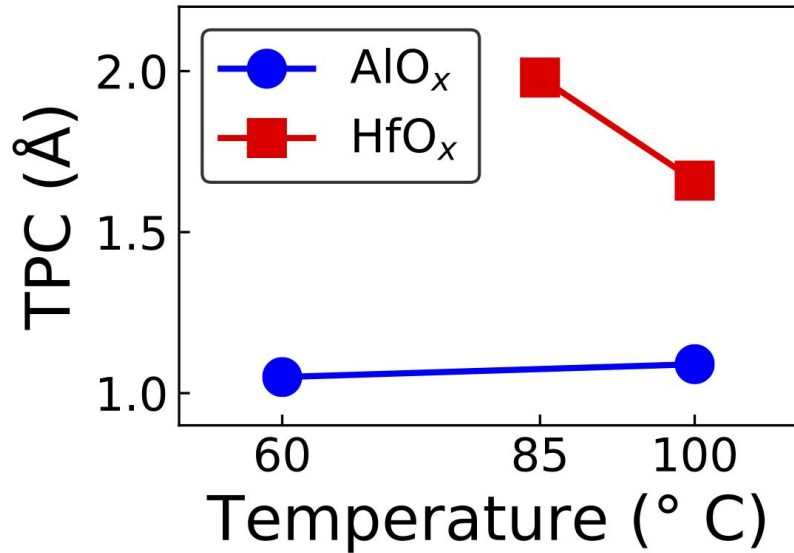


Benefit to SNF community



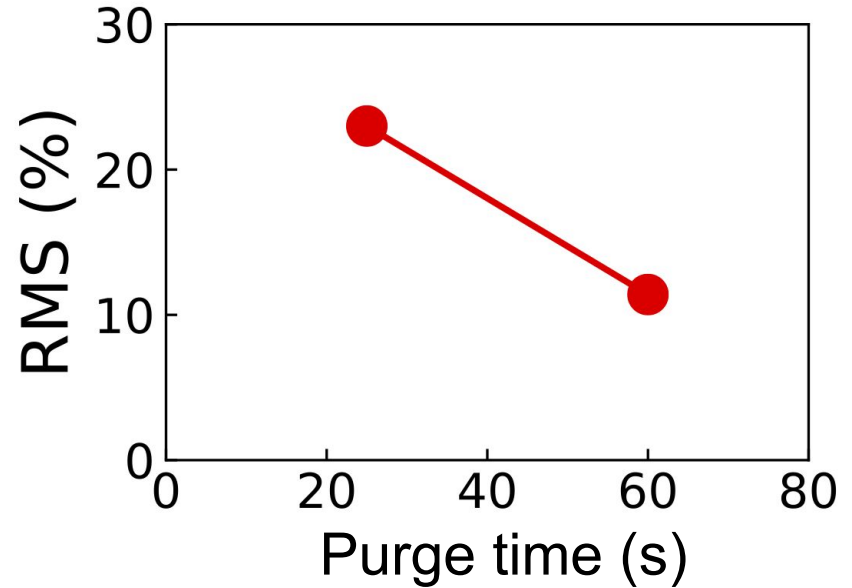
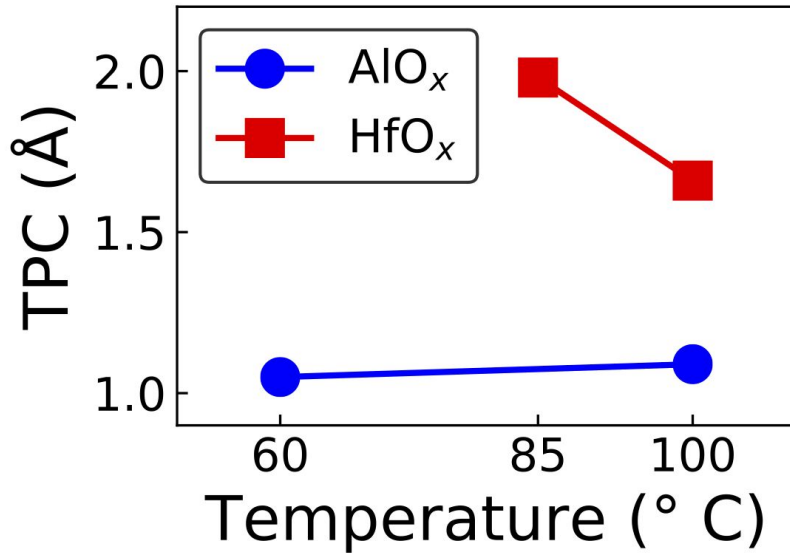


Low-Temperature AlO_x Process



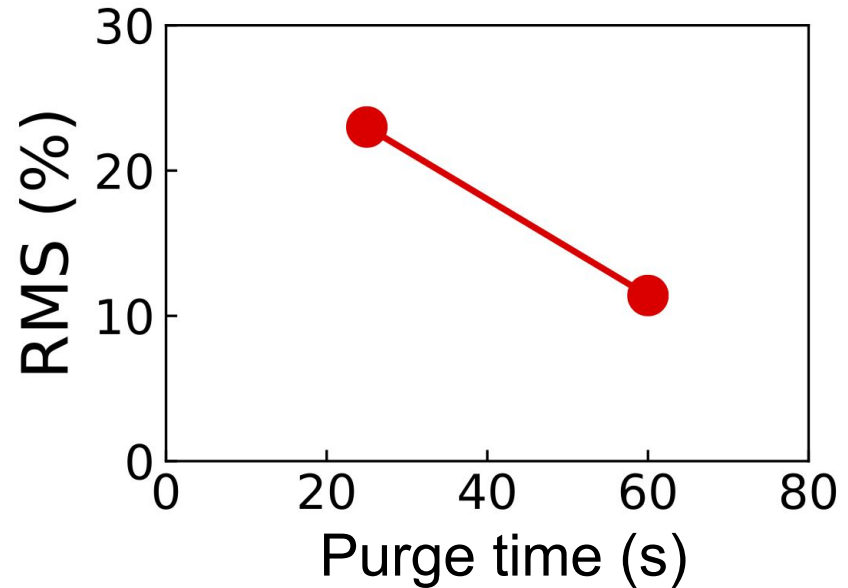
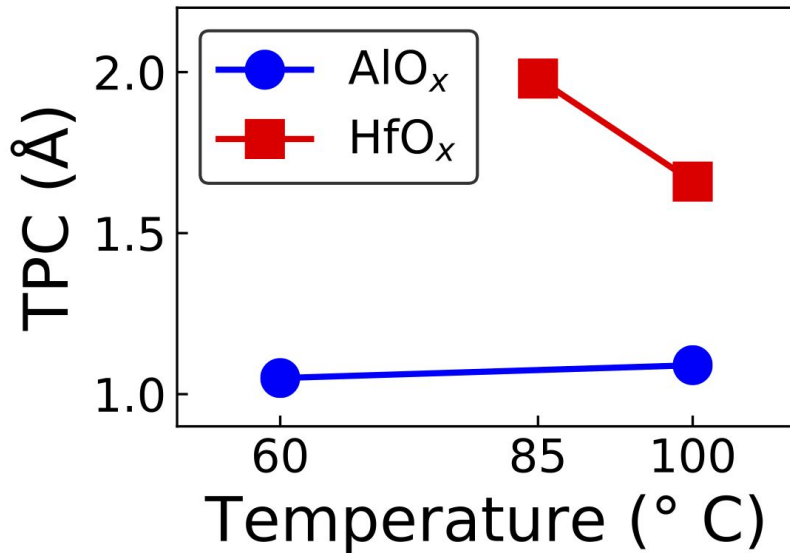


Low-Temperature AlO_x Process





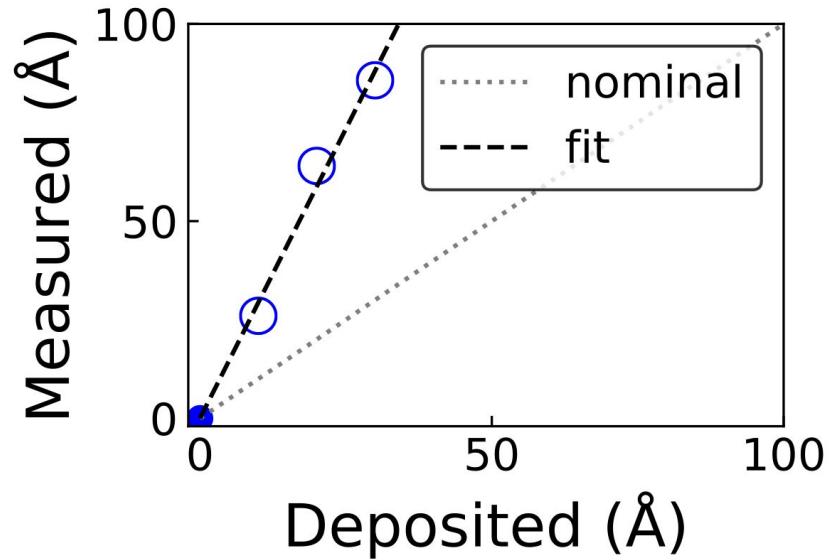
Low-Temperature AlO_x Process



→ Alumina growth stable at low deposition temperature. Long purge time needed for film uniformity

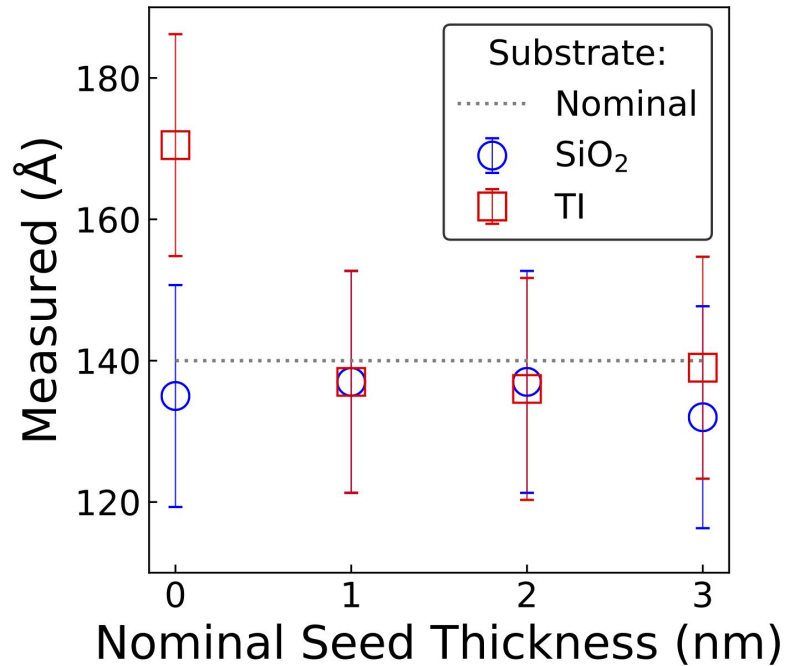
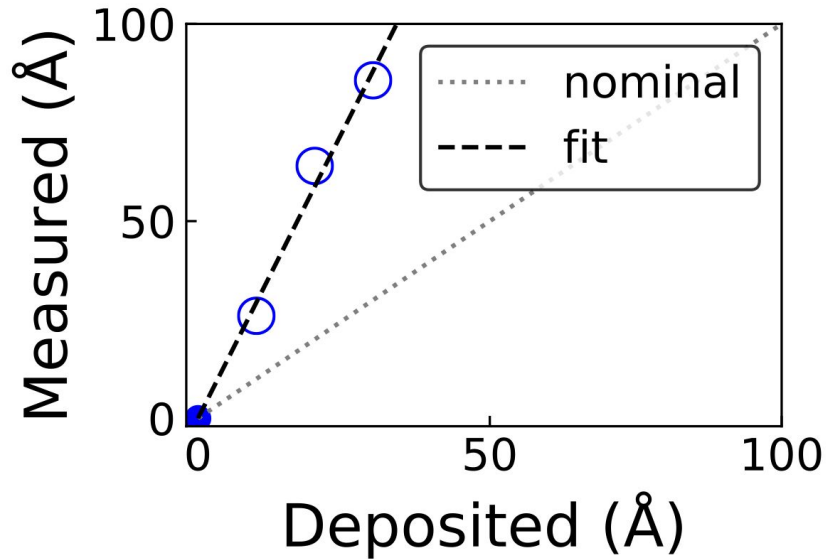


Seeded AlOx Process



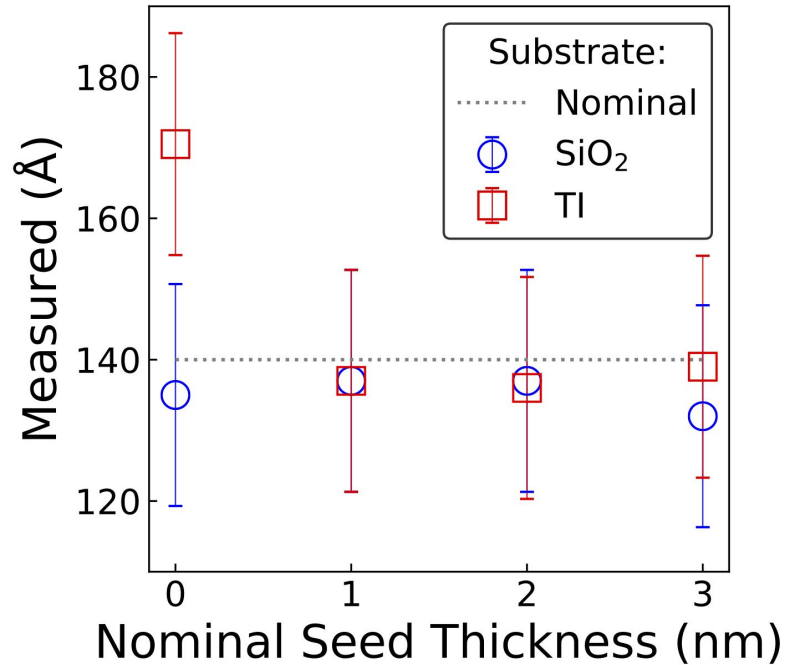
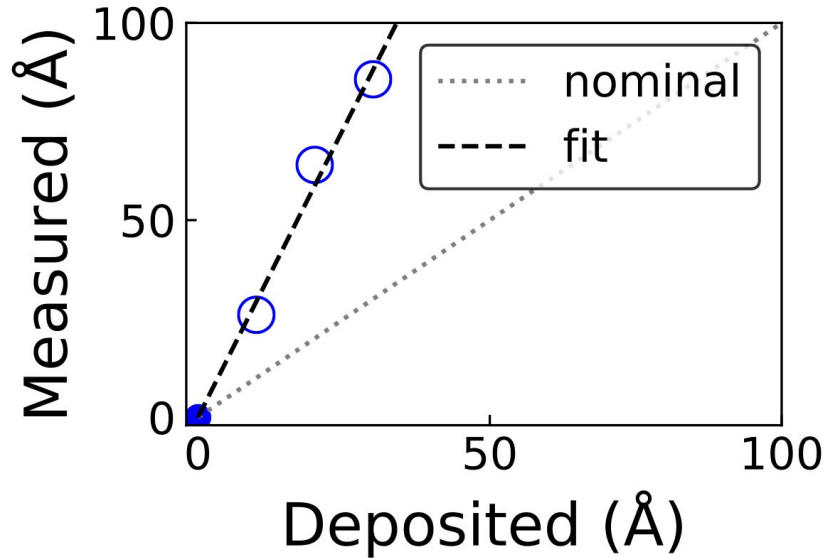


Seeded AlOx Process





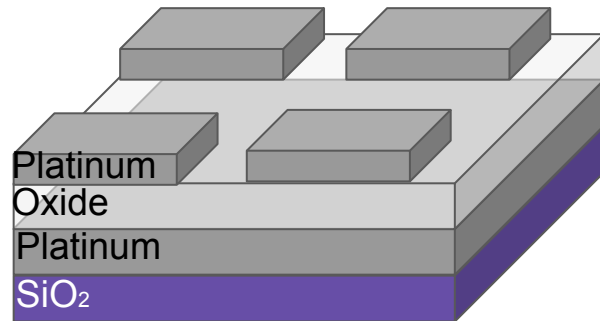
Seeded AlOx Process



→ Seeds swell x3 when oxidized. Little effect on ALD nucleation and growth

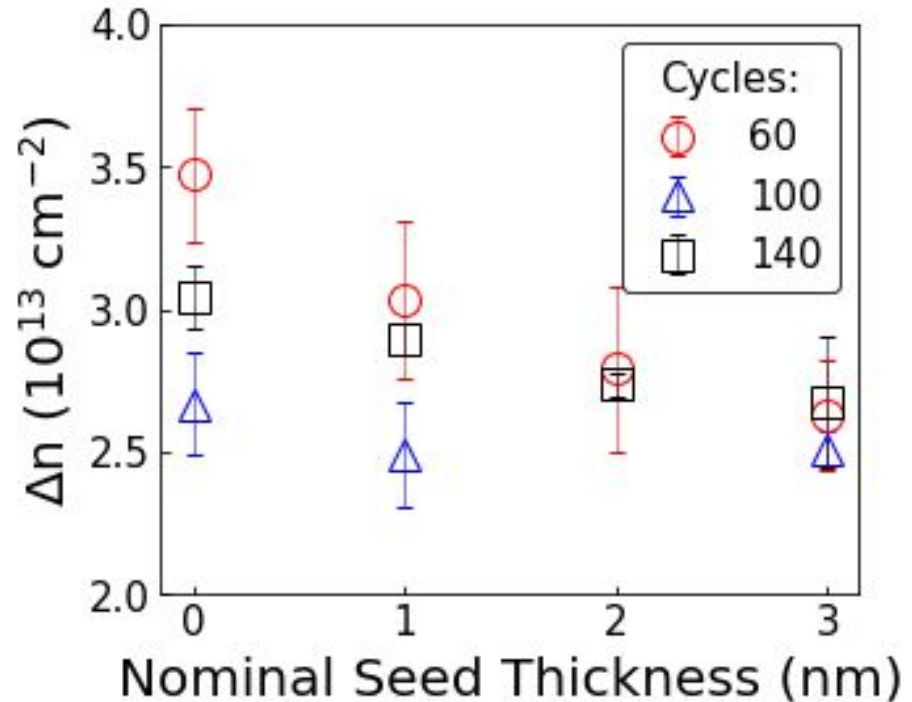
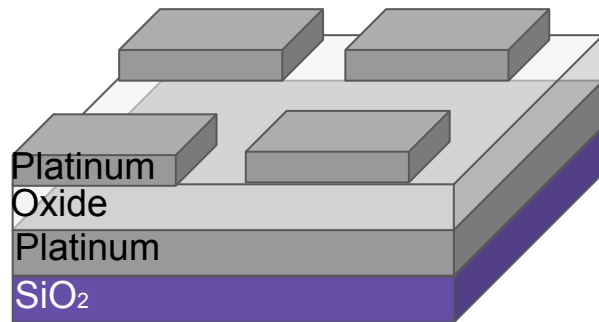


Gate Swings in Low-Temperature AlOx



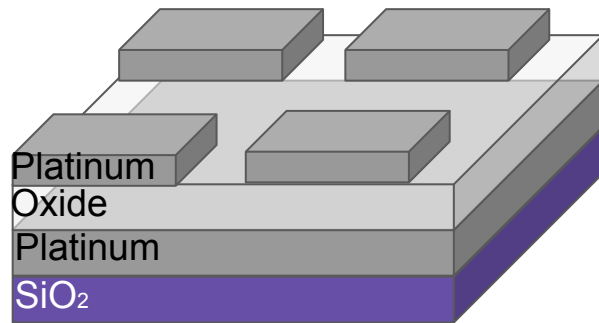


Gate Swings in Low-Temperature AlOx

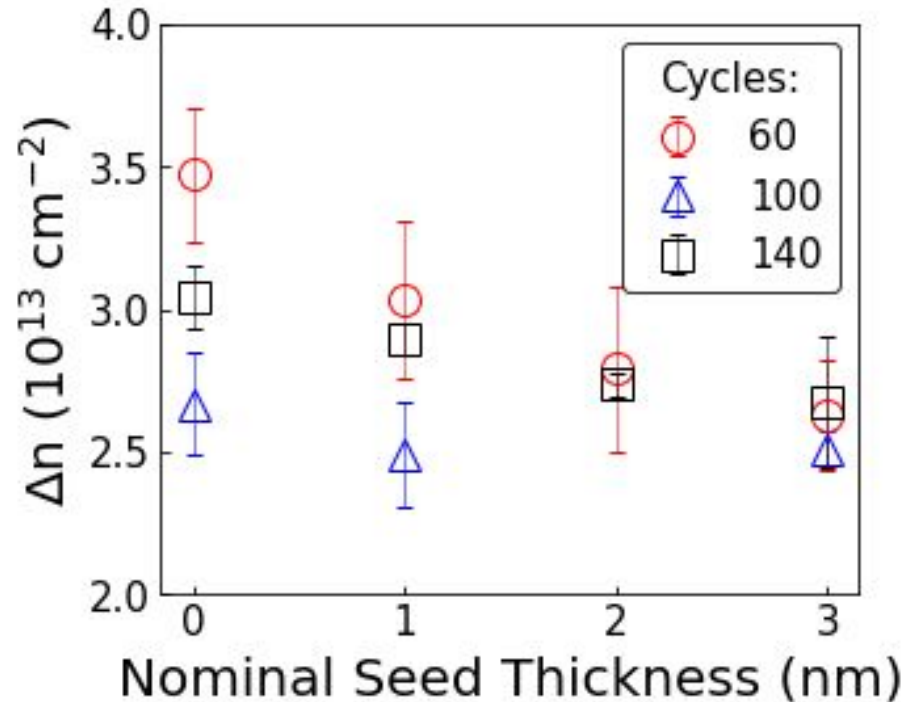




Gate Swings in Low-Temperature AlOx

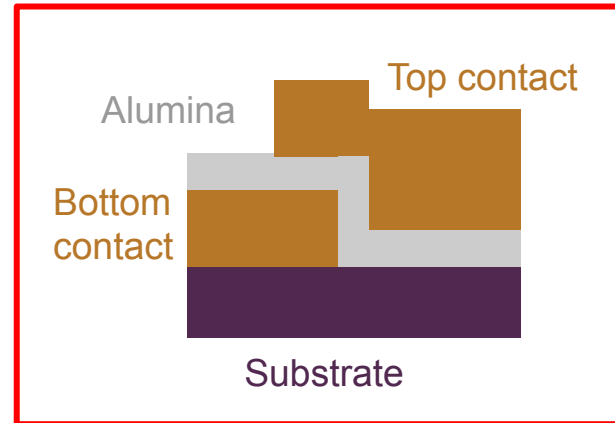
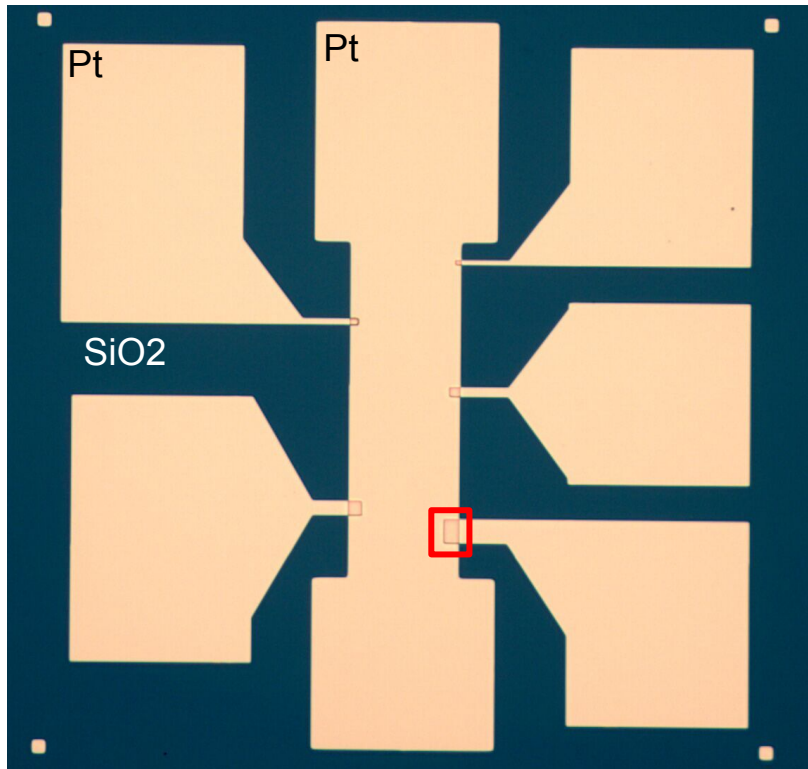


→ Seeds weakly decrease gate swing capabilities



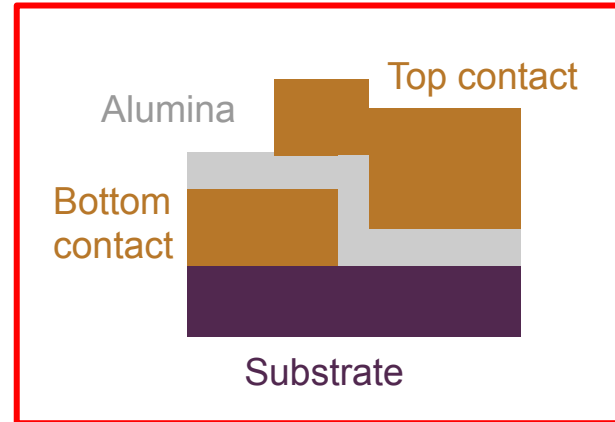
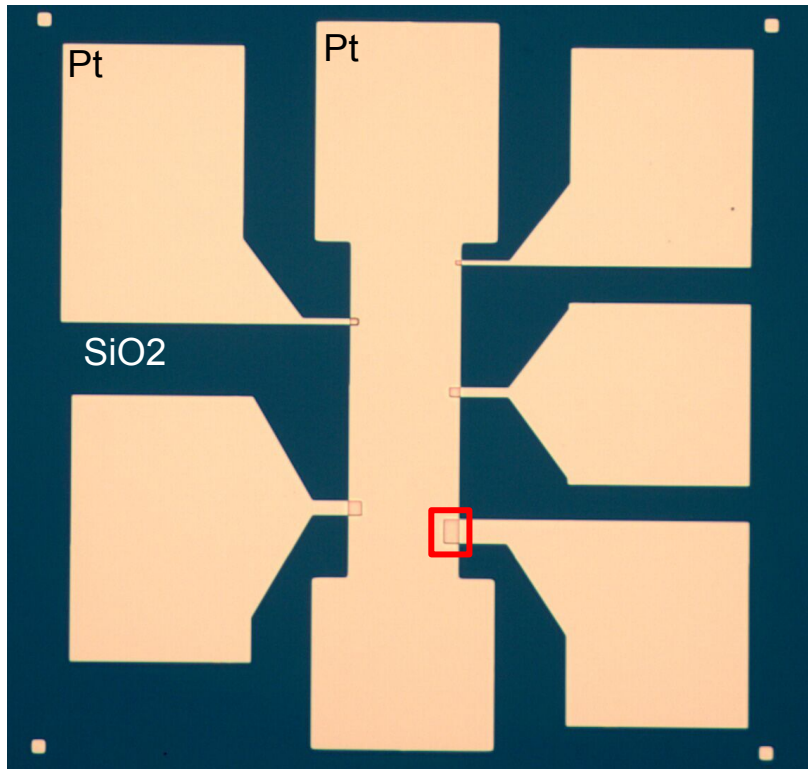


Tunnel Barrier Devices





Tunnel Barrier Devices

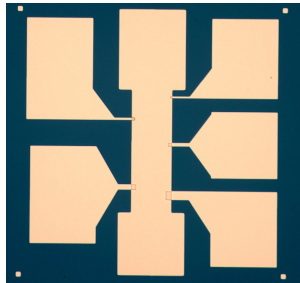


→ *Top contact lithography: develop resist without etching tunnel barrier (CD-30, AZ developer, MIBK)?*

Second Quarter Plans



Dielectric Characterization



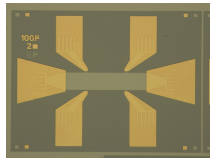
Superconducting NbN

1. Superconducting and physical properties vs. deposition parameters

2.

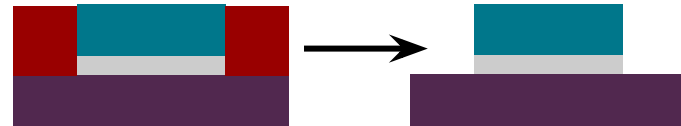


Damage Characterization



Measure carrier density and mobility before and after depositions

Patterned ALD





Budget

Savannah	\$50/hr	1993 min	\$1660
Micromanip.	\$5/hr	1309 min	\$109
XE-70 AFM	\$20/hr	432 min	\$144
Icon AFM	\$20/hr	589 min	\$196
Nova SEM	\$45/hr	64 min	\$48
Woollam	\$50/hr	188	\$157
KJL Evaporator	\$35/hr +\$0.63/nm Pt	687 min + 685 nm	\$833
ML3	\$20/hr	431 min	\$144
Leybold	\$60/hr	129 min	\$75
Training, misc.			\$303

Total expenditure
\$3,669



Extra slide: electrical properties

