EBL Process

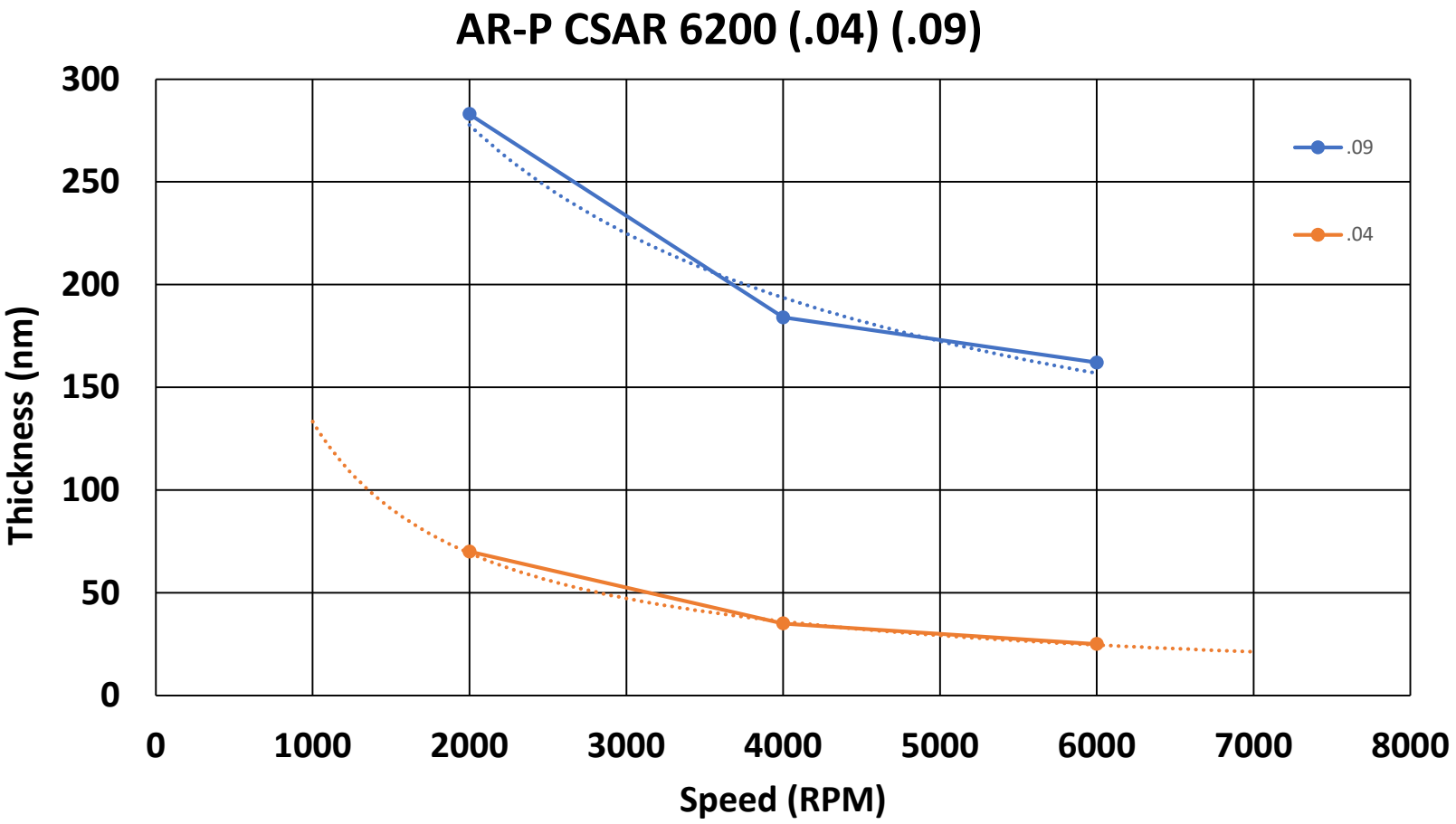
UD NanoFab

Positive EBL
AR-P 6200.04
AR-P 6200.09

Single layer resist suitable for etching
(RIE or Ion mill)

1. Spin (see reverse for spin curves) 60s
2. Bake 170^{o}C 300s
3. EBL exposure (base dose Si=200µC/cm^{2})
4. Develop AR 600-546 for 60s
5. IPA rinse, N_2 Dry

UD NanoFab


AR-P CSAR 6200 (.04) (.09)
Thickness (nm)
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
Speed (RPM)
.09
.04

EBL Process

UD NanoFab

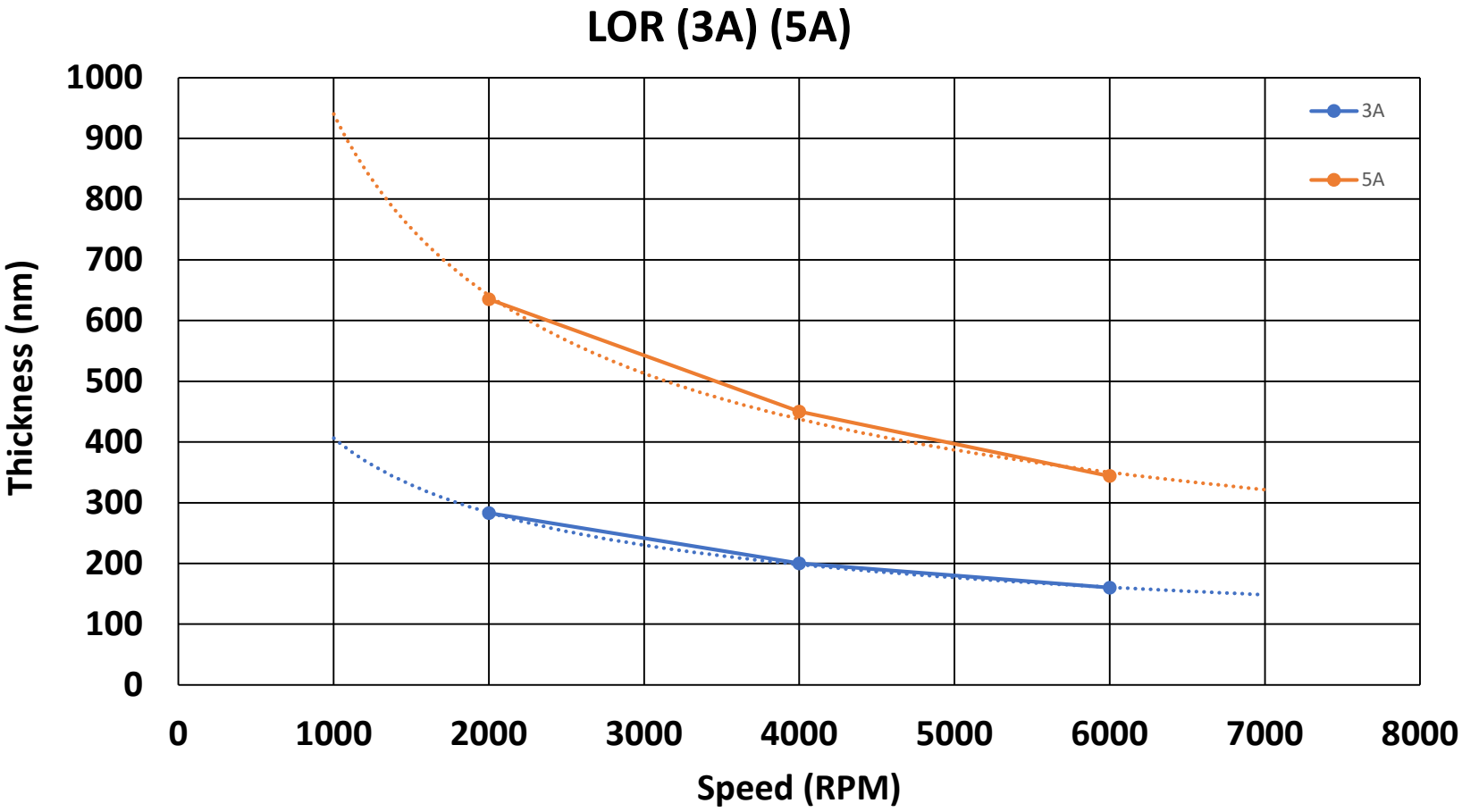
Positive EBL
LOR/AR-P 6200.04

Bi-layer process suitable for liftoff of films up to 100nm thick

1. Spin LOR 3A at 6000RPM 45s
2. Bake 200°C 300s (5mins)
3. Spin AR-P 6200.04 at 2000RPM 60s
4. Bake 170°C 300s (5mins)
5. EBL exposure (base dose Si =200µC/cm^2)
6. Develop (AR-P 6200.04) – AR 600-546 for 60s
7. IPA rinse, N_2 dry
8. Develop (LOR) – AR300-47 for 35s
9. DI rinse, N_2 Dry

For lift-off of films greater than 100nm the general rule is that the **bottom** resist layer (LOR) should be ≈x2 the metal evaporation thickness. The top layer can remain the same in most circumstances. Consult with staff if you are unsure.

UD NanoFab


LOR (3A) (5A)
Thickness (nm)
1000
900
800
700
600
500
400
300
200
100
0
0
1000
2000
3000
4000
5000
6000
7000
8000
Speed (RPM)
3A
5A

EBL Process

UD NanoFab

Positive EBL
PMMA 495K/950K

Bi-layer process suitable for liftoff of films up to 100nm thick

1. Spin PMMA 450K A4 at 4000RPM 60s
2. Bake 180°C 90s
3. Spin PMMA 950K A2 at 4000RPM 60s
4. Bake 180°C 90s
5. EBL exposure (base dose Si =300µC/cm^2)
6. Develop in 3:1 IPA:MIBK for 60s
7. IPA rinse, N_2 dry

For lift-off of films greater than 100nm the general rule is that the **bottom** resist layer should be ≈x2 the metal evaporation thickness. The top layer can remain the same in most circumstances. Consult with staff if you are unsure.

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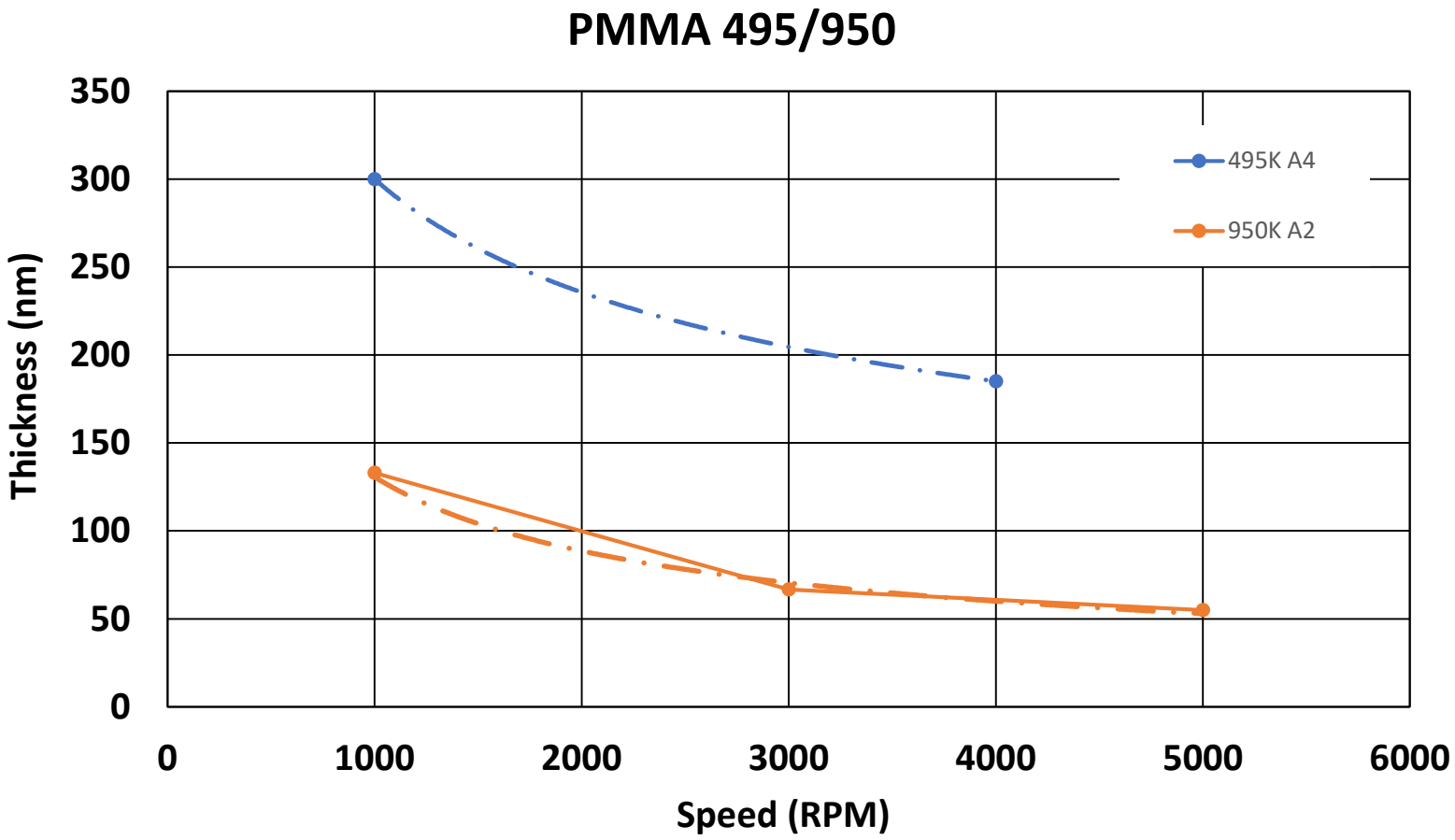


EBL Process

UD NanoFab

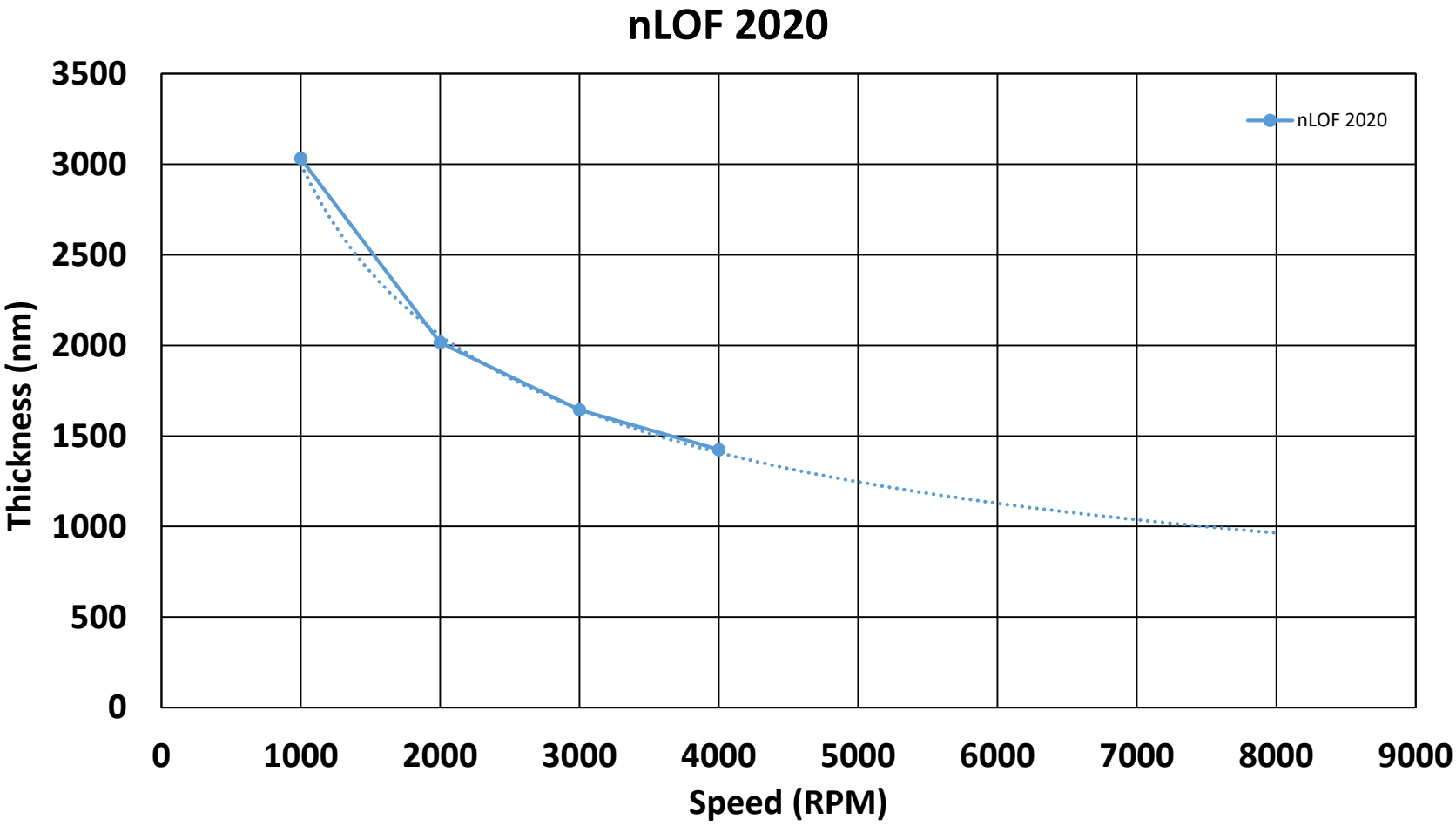
Negative EBL
nLOF 2020

1. Adhesion promoter*
2. Spin at 8000RPM 60s (1125nm)
3. Bake 110°C 60s
4. EBL exposure (base dose 100µC/cm^2)
5. Bake 110°C 60s
6. Develop AZ 300 MIF 60s
7. DI water rinse, N_2 Dry

nLOF 2020 is one of our standard photoresists, but can also be used for EBL. It is very thick for an ebeam resist and should only be used in special circumstances. Please consult UDNF staff before using this process.

*see adhesion promotion process instructions

UDNF
UD NanoFab



EBL Process

UD NanoFab

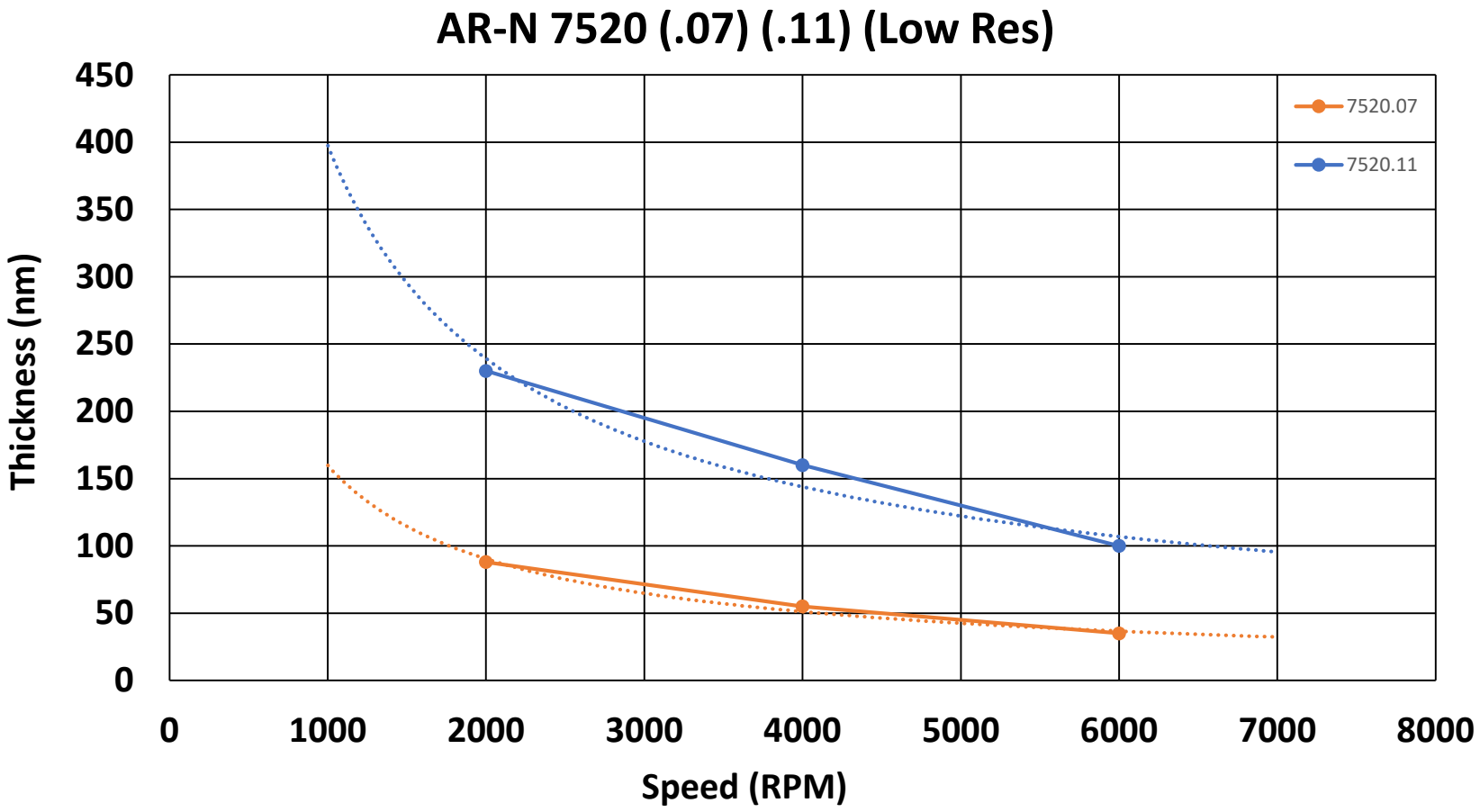
Negative EBL
AR-N 7520 (.07) (.11)

1. HMDS primer (oven)*
2. Spin at 4000RPM 60s
3. Bake 85ºC 60s
4. EBL exposure (base dose=200µC/cm2)
5. Develop AR 300-47 60s
6. DI water rinse, N_2 Dry

AR-N 7520.07 and AR-N 7520.11 is the LOW RESOLUTION version of the AR-N 7520 resists. This resist will print features down to 100nm but has poor LER.

*HMDS only required for to improve adhesion for Si/SiO_2 surfaces. For III-V materials adhesion promotion may not be necessary. If adhesion is a problem for your substrate please talk to staff for options.

UD NanoFab


AR-N 7520 (.07) (.11) (Low Res)
Thickness (nm)
450
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
Speed (RPM)
7520.07
7520.11

EBL Process

UD NanoFab

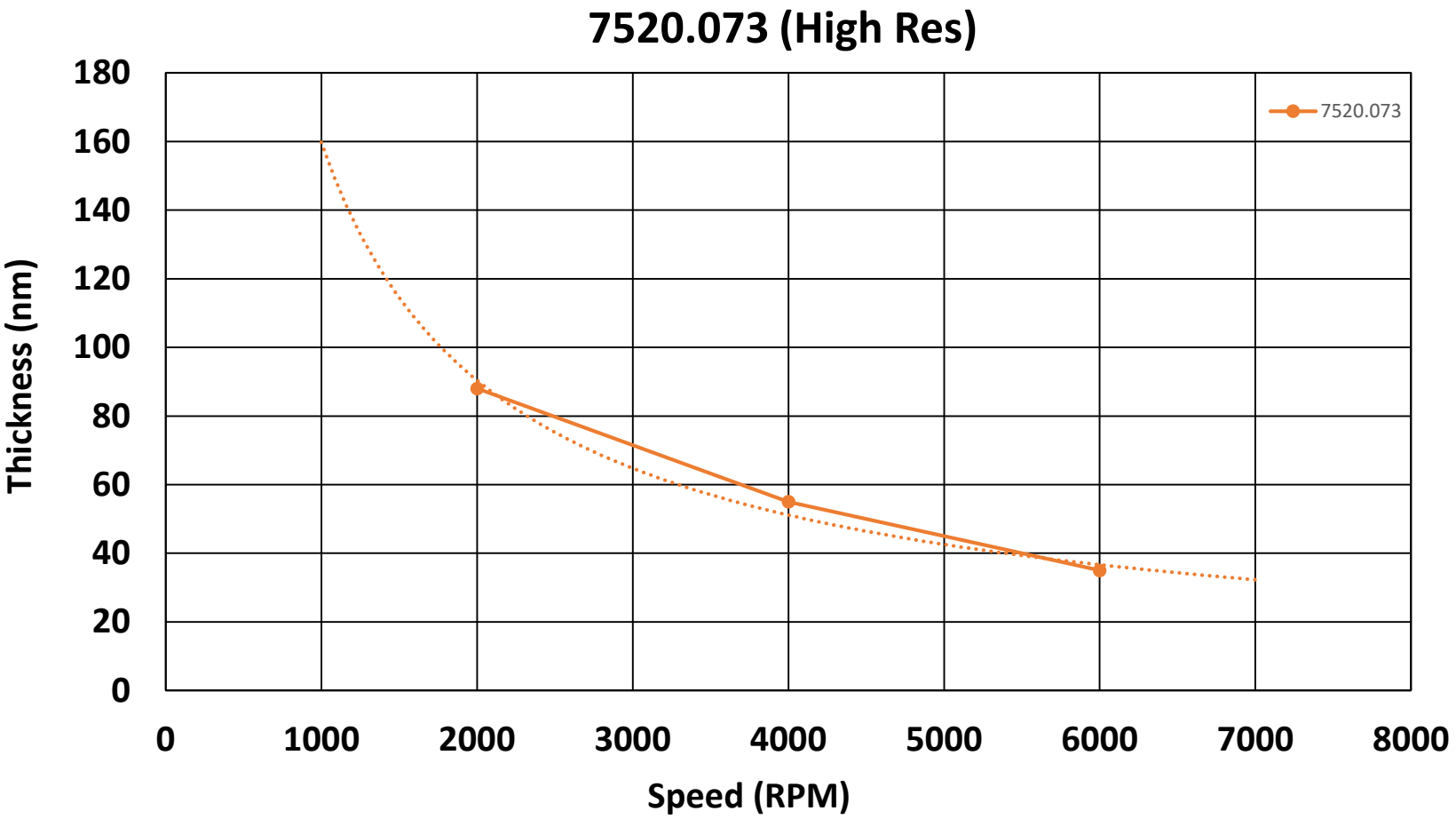
Negative EBL
AR-N 7520.073 (HR)

1. Adhesion promoter*
2. Spin (see reverse for spin curves) 60s
3. Bake 85ºC 60s
4. EBL exposure (base dose=920µC/cm2 for Si)
5. Develop AR 300-47 4:1 H_2O 50s
6. DI water rinse, N_2 Dry

AR-N 7520.073 is the HIGH RESOLUTION version of the AR-N 7520 resists. This resist will print features down to 30nm with good LER.

*see adhesion promotion process instructions

UD NanoFab


7520.073 (High Res)
Thickness (nm)
180
160
140
120
100
80
60
40
20
0
0
1000
2000
3000
4000
5000
6000
7000
8000
Speed (RPM)
7520.073

EBL Process

UD NanoFab

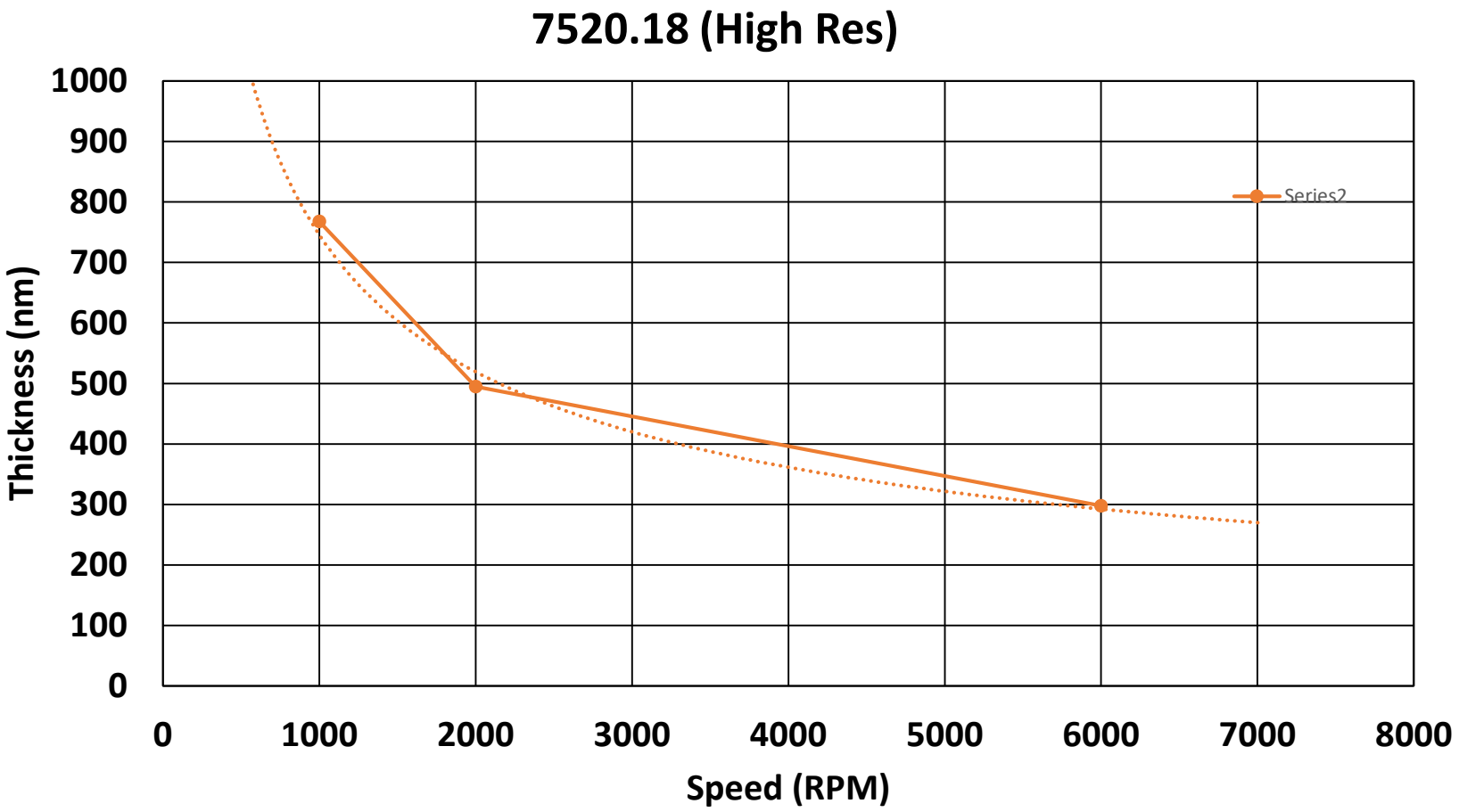
Negative EBL
AR-N 7520.18 (HR)

1. Adhesion promoter*
2. Spin (see reverse for spin curves) 60s
3. Bake 85°C 60s
4. EBL exposure (base dose=920µC/cm2)
5. Develop AR 300-47 4:1 H_2O 90s#
6. DI water rinse, N_2 Dry

*see adhesion promotion process instructions

#90s development will clear 400nm resist. For films greater than 400nm use 150s.

UD NanoFab


7520.18 (High Res)
Thickness (nm)
1000
900
800
700
600
500
400
300
200
100
0
0
1000
2000
3000
4000
5000
6000
7000
8000
Speed (RPM)
Series2

Photolithography Process

UD NanoFab

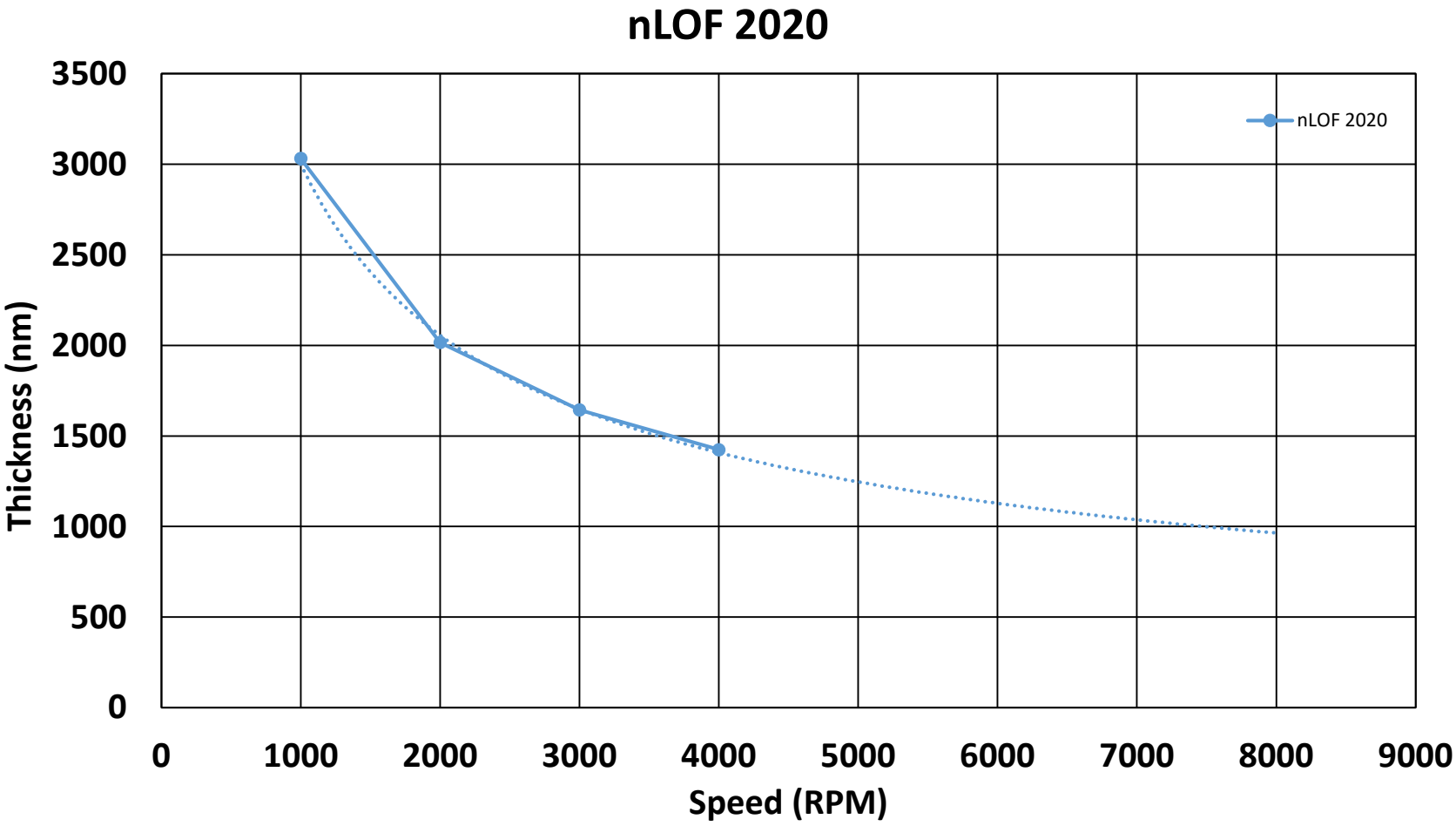
Negative Photoresist AZ nLOF 2020

Single layer resist recommended for etching
(RIE or Ion mill)

1. Adhesion promoter*
2. Spin at 4000RPM 60s (≈ 1.5µm)
3. Bake 110°C 60s
4. Exposure:
    1. Laserwriter: 450mJ/cm^2 (features >3um)
    2. Mask Aligner: exposure 20s (90mJ/cm^2 iline filter in)
5. Bake 110°C 60s
6. Develop AZ 300 MIF 60s
7. DI water rinse, N_2 Dry

*see adhesion promotion process instructions

UDNF
UD NanoFab



Photolithography Process

UD NanoFab

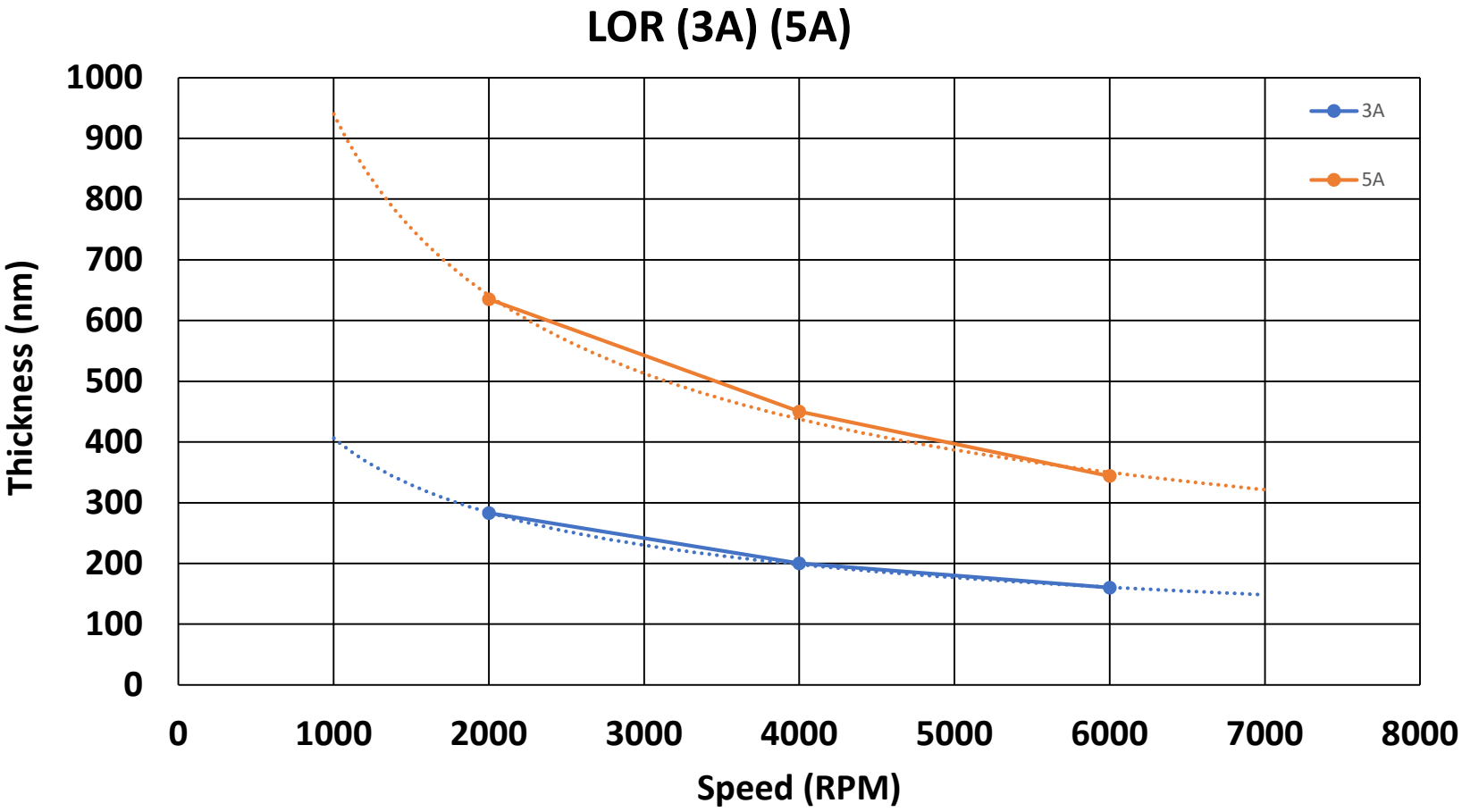
Negative Photoresist Liftoff LOR/AZ nLOF 2020

Bi-layer process recommended for liftoff of films up to 300nm thick

1. Adhesion promoter*
2. LOR 5A @ 6000RPM for 60s,
3. Bake 200 C for 5 min,
4. nLOF 2020 6000RPM for 60s,
5. Pre-exposure bake 90^{O}C for 90s,
6. Exposure:
    1. Laserwriter: 450mJ/cm^2 (features >3um)
    2. Mask Aligner: exposure 20s (135mJ/cm^2 iline filter in)
7. Post exposure bake at 110^{O}C for 90s,
8. Develop AZ 300K MIF for **120s** seconds.

*see adhesion promotion process instructions- adhesion promotion is almost never needed with LOR

UD NanoFab


LOR (3A) (5A)
Thickness (nm)
1000
900
800
700
600
500
400
300
200
100
0
0
1000
2000
3000
4000
5000
6000
7000
8000
Speed (RPM)
3A
5A

Photolithography Process

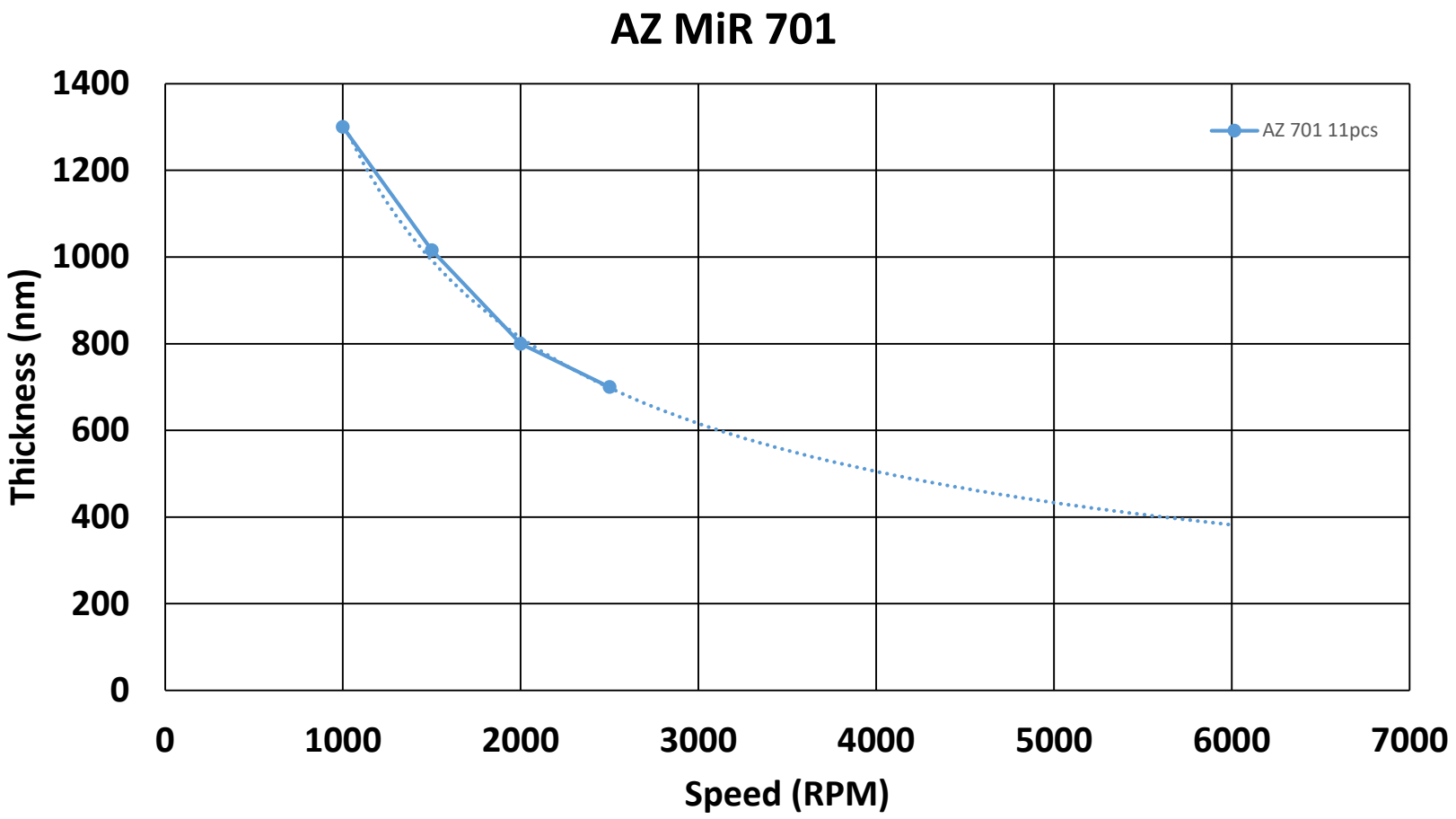
UDNF
UD NanoFab

Positive Photoresist
AZ MiR 701

1. Adhesion Promotion (if required)*
2. Spin at 4000RPM 60s
3. Bake 90°C 90s
4. Exposure:
   a. Mask Aligner: exposure 45s (220mJ/cm^2 iline filter in)
   b. Laserwriter: 500mJ/cm^2 (features >3um)
5. Bake 110°C 90s
6. Develop AZ 300 MIF 60s
7. DI water rinse, N_2 Dry

*see adhesion promotion process instructions

UD NanoFab


AZ MiR 701
Thickness (nm)
1400
1200
1000
800
600
400
200
0
0
1000
2000
3000
4000
5000
6000
7000
Speed (RPM)
AZ 701 11pcs

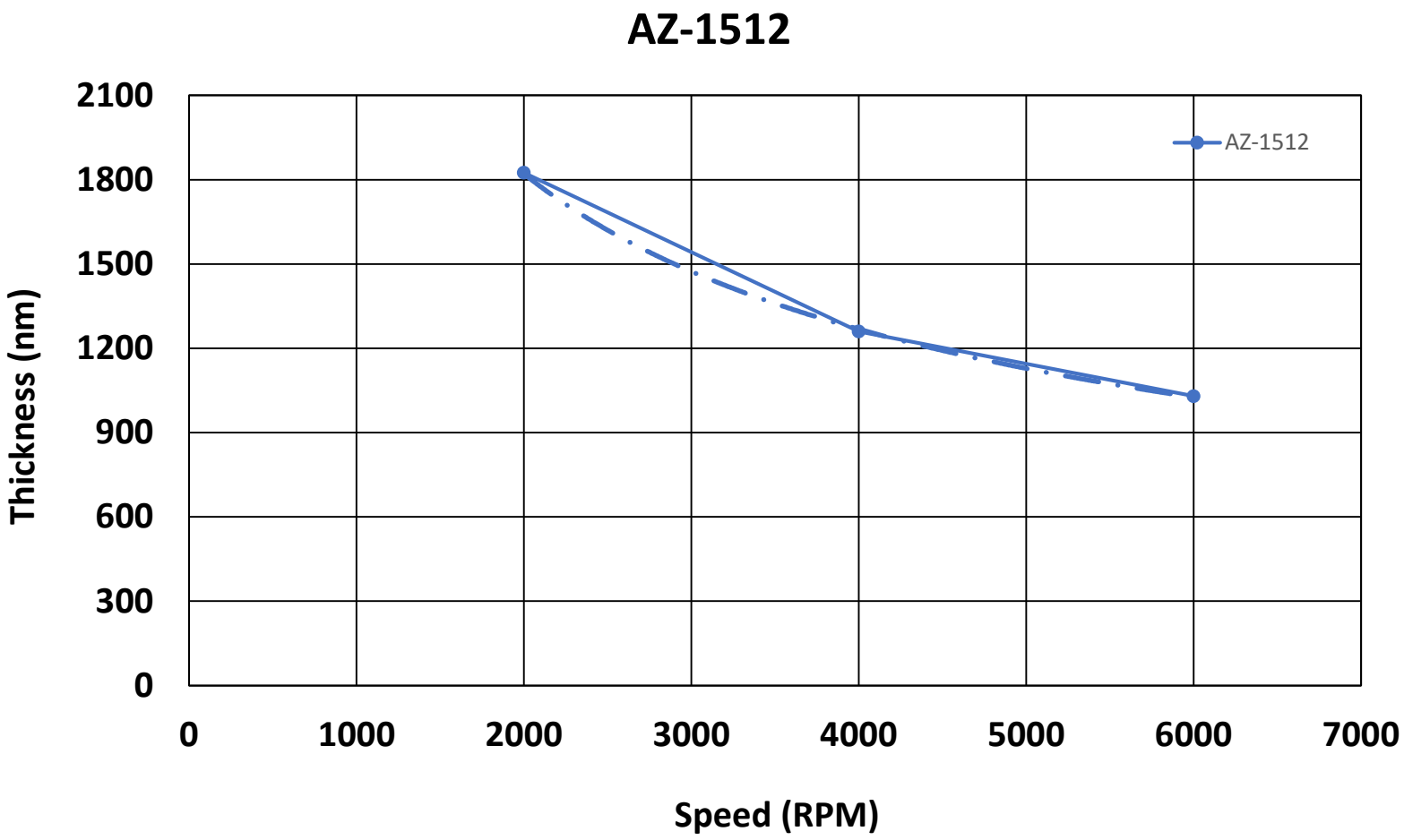
UD NanoFab

Positive Photoresist AZ 1512

1. Adhesion Promotion (if required)*
2. Spin at 4000RPM 60s
3. Bake 90°C 90s
4. Exposure:
    a. Laserwriter: 150mJ/cm^2 (features >3um)
    b. Mask Aligner: exposure 10s (135mJ/cm^2 iline filter in)
5. Bake 110°C 60s
6. Develop AZ 300 MIF 60s
7. DI water rinse, N_2 Dry

*see adhesion promotion process instructions

UD NanoFab


AZ-1512
Thickness (nm)
2100
1800
1500
1200
900
600
300
0
0
1000
2000
3000
4000
5000
6000
7000
Speed (RPM)
AZ-1512

UD NanoFab

Positive Photoresist Liftoff LOR/AZ 1512

Bi-layer process recommended for liftoff of films up to 300nm thick

1. Adhesion Promotion (if required)*
2. LOR 5A @ 6000RPM for 60s,
3. Bake 200 C for 5 min,
4. Spin AZ 1512 at 4000RPM 60s
5. Bake 90^{o}C 90s
6. Exposure:
    a. Laserwriter: 150mJ/cm^2 (features >3um)
    b. Mask Aligner: exposure 10s (135mJ/cm2 iline filter in)
7. Bake 110^{o}C 60s
8. Develop AZ MIF 300 120s
9. DI water rinse, N_2 Dry

*see adhesion promotion process instructions- adhesion promotion is almost never needed with LOR

Adhesion Promotion

UD NanoFab

How well a resist will adhere to a surface is linked to the contact angle formed at the interface. Many substrate/photoresists interfaces will need a promoter, often AR-N 7520.XX also will. AR-P6200 and PMMA/MMA will rarely need promoters. If the process uses LOR as the bottom of a liftoff bilayer a promoter is also rarely needed. NOTE: rarely does not mean never – there are always exceptions. This advice only refers to adhesion of resist through the normal lithography process and does not extend to adhesion through wet etching or electroplating

AR 300-80
(Allresist adhesion promoter)

AR 300-80 is an adhesion promoter from Allresist and has been used successfully with a variety of resists including AR-N 7520.XX, AR-P 6200.XX and both positive and negative photoresists. AR 300-80 is also an alternative to HMDS for Si/SiO_2 substrates.

1. **Spin at 4000RPM 60s (film thickness ≈15nm)**
2. **Bake 170^{o}C 120s**
3. **Spin resist following the resist recipe**

Surpass 3000/4000

1. **Spin at 3000RPM 60s or immersion in a beaker**
2. **Rinse with water or IPA**
3. **dry**

Use Surpass 3000 for AR-P 6200, PMMA,HSQ
Use Surpass 4000 for AZ1512

HMDS

In general HMDS is only recommended for to improve adhesion for Si/SiO_2 surfaces. It may work with other oxide surfaces.

To use HMDS follow the instructions next to the HMDS oven.

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Spin on Conductive Film AR-PC 5090.02 or 5091.02

AR-PC 509**0**.02 for PMMA, AR-P 6200 series and HSQ

AR-PC 509**1**.02 for AR-N 7520

Conductive polymers help to reduce charging effects when using EBL. If you are using an insulating substrate (SiO_2, Al_2O_3, Diamond) you should use this on the top of your resist. It must be removed after EBL exposure and before development

1. Spin at 2000RPM 60s (≈ 60nm)
2. Bake 90°C 120s
3. EBL exposure
4. DI water rinse, N_2 Dry

UDNF
UD NanoFab

Resist for Dicing Protection

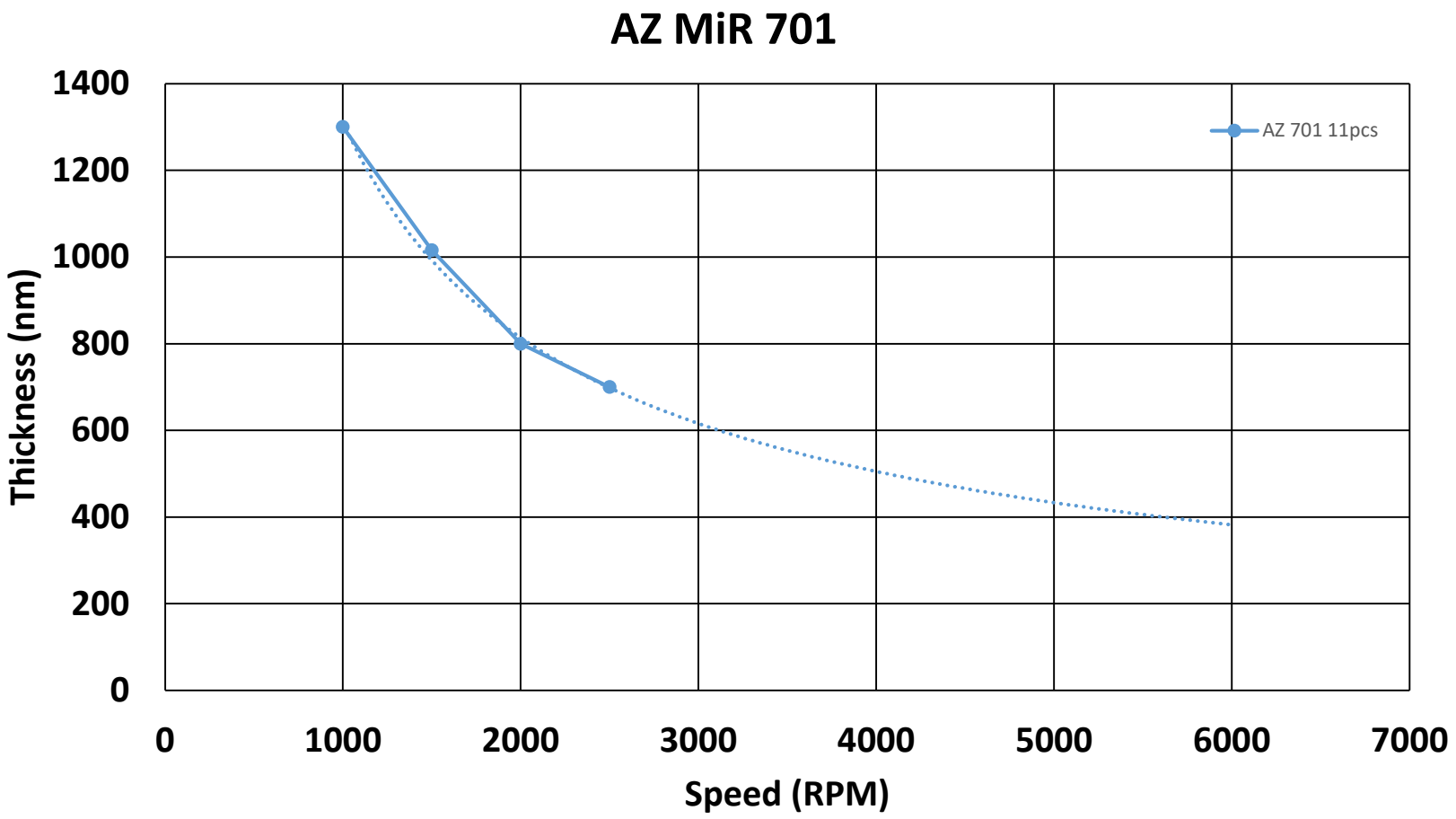
Dicing is a very messy process. It is absolutely necessary to coat your part with a protective layer prior to dicing. In our experience it is impossible to clean samples after they have been diced without a protective layer. We provide an expired resist that is no longer used for lithography (AZ MiR 701) in use for this purpose.

1. Spin AZ MiR701 at 2000RPM 60s
2. Bake 90^{o}C 60s
3. Hand part to UDNF staff for dicing

After parts have been diced the resist can be stripped using NMP or Acetone followed by O_2 plasma in the Asher (if your process allows).

We recommend keeping the diced parts covered in the resist until you are ready to use them.

UD NanoFab


AZ MiR 701
Thickness (nm)
1400
1200
1000
800
600
400
200
0
0
1000
2000
3000
4000
5000
6000
7000
Speed (RPM)
AZ 701 11pcs