EM RESIST LTD
SPECIALISTS IN RESIST TECHNOLOGY

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PMMA Resist – Datasheet

Features

Film Thickness:

0.5 – 5 µm

Industry Standard

High Resolution

Versatile

Introduction

PMMA (polymethyl methacrylate is a widely used, versatile, positive tone electron beam resist. It is used in many micro and nano-electronic applications. Typically exposed using direct write e-beam lithography, PMMA can also be exposed with x-ray and deep UV mirolithography processes.
In addition to its lithography properties, PMMA can be used in other micro and nanoelecronics applications as a sacrificial layer, protective coating for wafer thinning or as a bonding adhesive.

EM Resist can supply PMMA with a range of film thickness and molecular weights. Standard molecular weights are 950,000, 495,000, 350,000, however EM Resist can also supply molecular weights if 35,000 & 120,000. All PMMA resins are supplied in the safe solvent Anisole.

We also offer copolymer P($MMA_{0.7}$-$MAA_{0.3}$) in ethyl lactate. This copolymer is typically used in lift-off applications where a deep undercut is required.

Processing Conditions

Substrate Preparation

PMMA can be spun on a range of substrates without adhesion layers. Ensure that the substrate is clean and dry. Substrate cleaning can be performed using solvents, O_2 Plasma and O_3.

Coat

EM Resist products are coated on the substrate using a spin coating process. The film thickness spin curves for our most common products are displayed below. These provide the information required to select the PMMA dilution for the desired film thickness.

Recommended coating conditions:

Dispense:	Static 5-8 mL for a 150 mm wafer.
Spread:	Dynamic – 500 rpm for 5s Static – 0 rpm for 10s
Spin:	Ramp to final speed selected from spin curves at high accelerations rate. Hold for 45s

Soft Bake

PMMA

Hotplate:	180°C for 60 – 90 s
Convection Oven:	170°C for 30 min

Copolymer

Hotplate:	150°C for 60 – 90 s
Convection Oven:	140°C for 30 min

Exposure

Electron beam lithography: Dose 50 – 500µC/cm^2 depending on electron source, equipment, exposure energy and developer used.

Energy – 20 – 50kV: Higher kV for higher resolution

DUV (Deep UV): Low sensitivity, requiring doses >500mJ/cm^2 @ 248nm

X-ray: Low sensitivity, 1-2 J/cm^2 @ 8.3A. Sensitivity increases at longer x-ray wavelengths.

Develop

PMMA and Coploymer resists can be developed using immersion (21°C), spray puddle and spray process techniques. The process conditions that are selected, such as resist selection, baking conditions, exposure conditions and development conditions, should be selected to optimised the desired results.

Product	Composition	Resolution	Sensitivity/Throughput
PMMA-Dev1	1:1 MIBK/IPA	Medium	High
PMMA-Dev2	1:2 MIBK/IPA	High	Medium
PMMA-Dev3	1:3 MIBK/IPA	Very High	Low
PMMA-Dev4	MIBK Pure	Low	High
PMMA-Dev*i*	3:7 Water/IPA	Very High	Very High

Rinse and Dry

Upon Completion of the development process and to prevent scumming, the resist should be immersed or sprayed with alcohol or DI water immediately.

Substrates can be spin dried at 3000rpm for 20s or blow dried with a dry, inert gas (Typically N_2).

Hard-bake (optional)

A postbake or hardbake can be used to remove residual developer, moisture or rinse solvent from the remaining resist layer.
Note that PMMA will re-flow above 125°C.

Hotplate:	100°C for 60 – 90 s
Convection oven:	95°C for 30 min

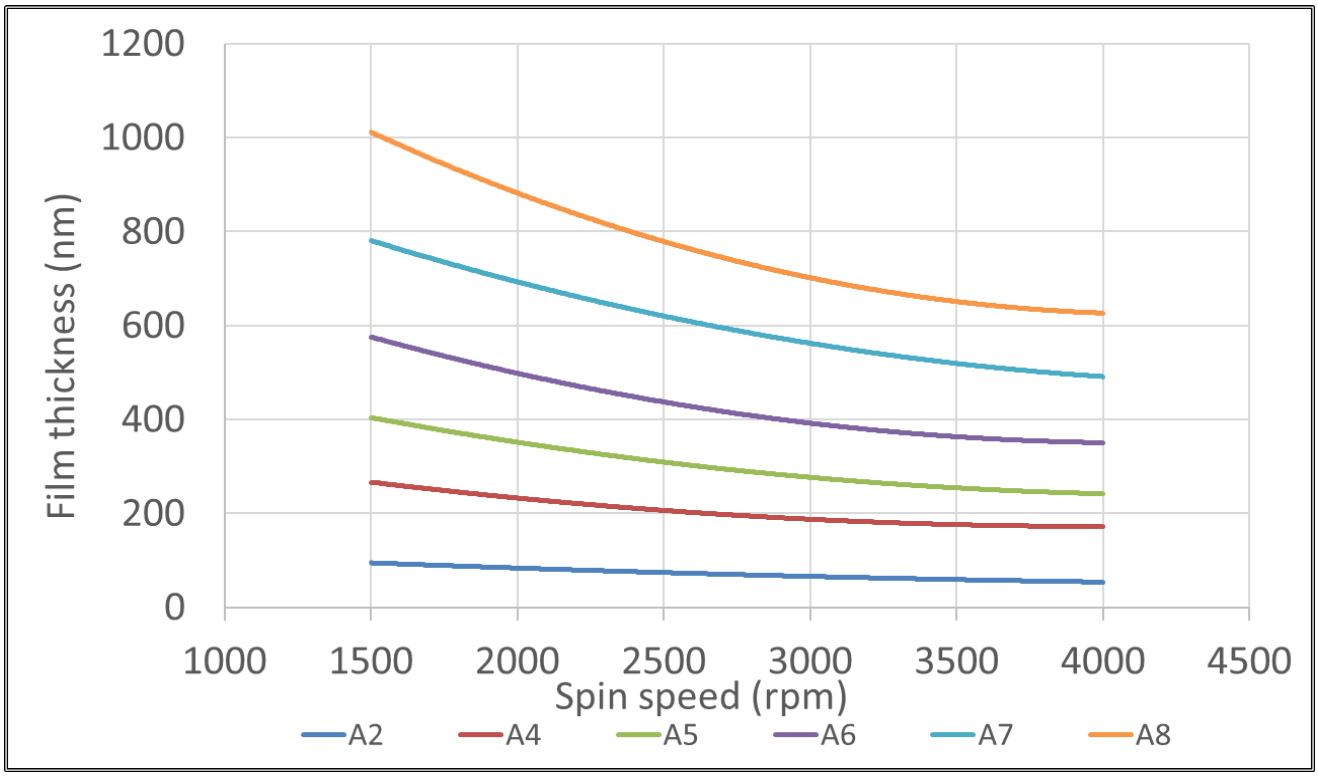
Removal techniques

Wet:	Photoresist remover, Acryl strip or standard laboratory solvents (Acetone)
Bath:	Time as required at ambient temperature
Spray:	Time as required, 500-1000 rpm
Dry:	Plasma O2

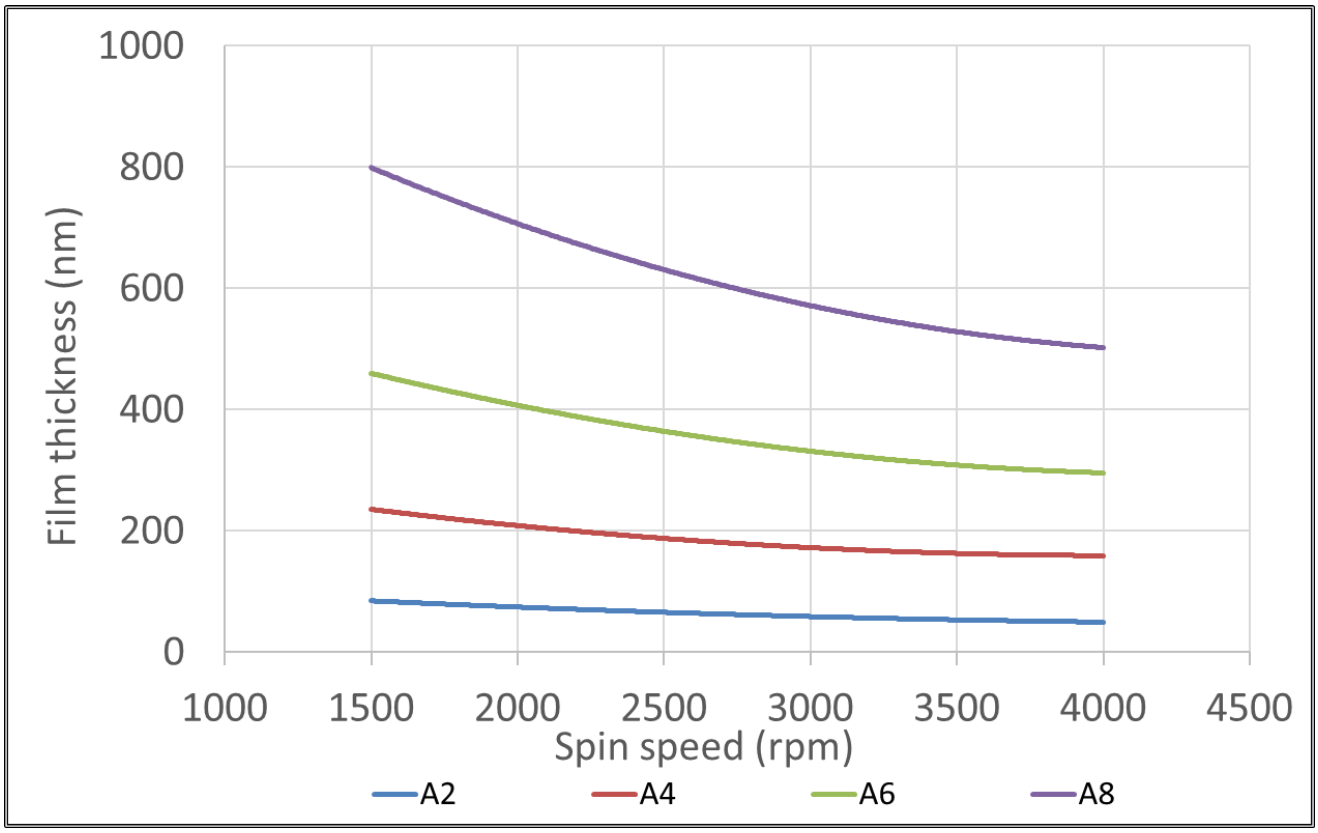
Spin Curves

The spin curves shown below are for PMMA and copolymer resists. They show the film thickness that is obtained based on the spin speed that is selected. This data provides approximate information to allow for the selection of the correct product/dilution for your application and desired film thickness. Actual results will vary based on equipment, environment, process conditions and application. Additional dilutions are available upon request.

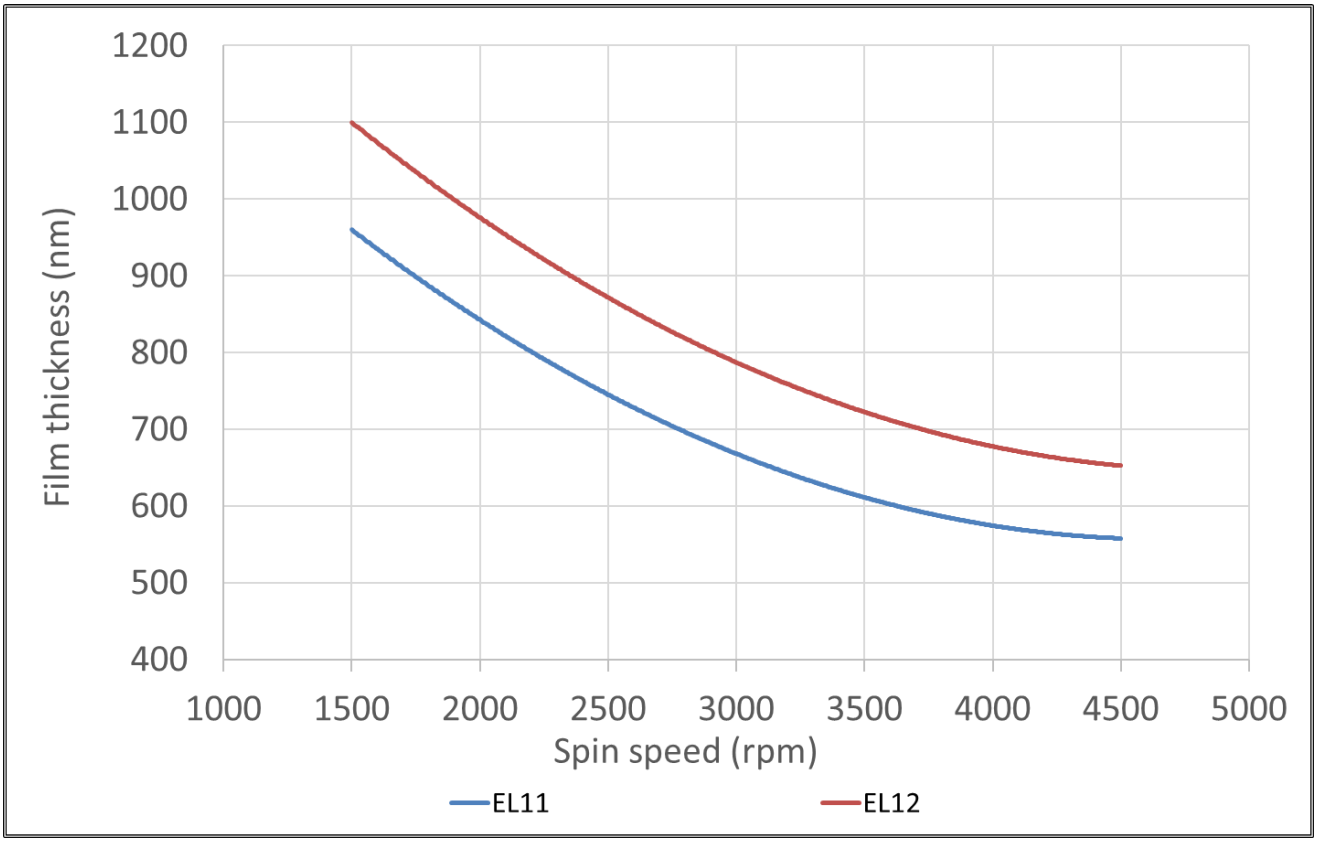
PMMA 950K in Anisole



PMMA 495K in Anisole



P(MMA 8.5 MAA) in ethyl lactate



Optical Data

PMMA Resist absorption curve