

Best Known Method: Line/Space Roughness Measurement Data Collection

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Item	BKM	Notes
Averaging	Min: 100 features Preferred: > 400 features	Averaging is your friend when measuring roughness. You want many features per image, and many images to average together. The images being averaged together should be nominally the same (same pattern type and size and the same process conditions). Counting all the features in all the images that will be averaged together, it is best to have a minimum of 100 features, but greater than 400 is preferred. The required number of features to use depends on the desired size of the error bars on your results.
Image Size	Min: 512x512 Better: 1024x1024 Best: 2048x2048	The more pixels the better
Feature Length	Min: 50-100 times correlation length	Line length in each image should be at least 50 – 100 times the correlation length in order to capture low-frequency roughness variations and obtain good PSD(0) estimates. For older KrF or ArF processes, a line length of 2 microns was generally sufficient. For advanced ArF immersion processes, smaller correlation lengths mean that shorter lines (1 to 1.5 microns) may be adequate. For EUV processes that have very short correlation lengths, line lengths of 1 micron are almost always adequate, and shorter line lengths may be acceptable.
X pixel size	Max: 2-3% of feature size	For example, one might use 1.3 nm x-pixels for 45 nm wide lines and spaces, 0.8 nm x-pixels for 25 nm lines and spaces, and 0.5 nm x-pixels for 16 nm lines and spaces. Tradeoffs: Larger x-pixel size allows more features per image; smaller pixel size gives better edge measurement resolution.
Y pixel size	Max: 1/5 of correlation length	For older KrF or ArF processes, a y-pixel size of 5 nm or less could be adequate. For advanced ArF immersion processes, smaller correlation lengths mean that smaller y-pixels (under 2 nm) are needed. For EUV processes that have very short correlation lengths, a y-pixel size of 1 nm or less is needed. Tradeoffs: Small y-pixels enable better measurement of high-frequency SEM noise, increasing the accuracy of unbiased parameter estimates. Larger y-pixels result in longer line lengths (for a given number of pixels in the image), and thus better PSD(0) estimates.
Image file type	Uncompressed	Uncompressed images such as TIFF
Filtering/Smoothing	Unprocessed images	All image filtering and smoothing should be turned off. Filtering throws away high-frequency information that must be measured in order to unbiased the measured roughness
Example ideal settings		For an ArF immersion process and 45nm line/space patterns, use a 1024x1024 image with 1.3 nm square pixels, or a 2048x2048 image with 0.8 nm square pixels., For an EUV process and 16nm line/space patterns, use a 1024x1024 image with 0.8 nm square pixels, or a 2048x2048 image with 0.5 nm pixels.