# UV light from ambient environment increases the $Si_3N_4$ etch rate in $XeF_2$ etching

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Releasing mechanical structures is a fundamental step in MEMS processing. Given the wide usage of silicon nitride ($Si_3N_4$) on silicon (Si) carrier due to high stress and high mechanical $Q$ factors, high etching selectivity between $Si_3N_4$ and Si is very crucial for the release process. Here we demonstrate that UV light from ambient light sources in a cleanroom environment (EPFL - CMi) can increase the etch rate of $Si_3N_4$ using $XeF_2$ therefore reduce the selectivity to the substrate (Si). By blocking the top window of the $XeF_2$ etching chamber and blocking the light, we see an enhancement by a factor of 3 in the selectivity between $Si_3N_4$ and Si.

Keywords: $Si_3N_4$; $XeF_2$; Dry etching; MEMS

We use an in-house $XeF_2$ etching chamber with 3 pulses of 2.5 Torr each lasting for 30 seconds. We measure the $Si_3N_4$ thickness before and after this process using film optical interferometry tool ("FilMetric") once with the top lid of the $XeF_2$ chamber covered with aluminum foil (blocking the light completely), and once with leaving the top lid uncovered. The selectivity between Si and $Si_3N_4$was then measured and compared for both cases. The Si:$Si_3N_4$ selectivity is 19:1 for the case with light exposure present inside the etching chamber, compared to 61:1 when the top lid was covered therefore no UV light exposure.

This method can enable release of $Si_3N_4$ on Si mechanical structures with better performance and lower etching of the active structure. This effect has been observed and used in 3D UV enhanced lithography by Sugano et al.

This method can also be used according to Sugano et al. to enhance selectivity of $SiO_2$ over Si and therefore can be potentially used to enhance surface quality of optical microdisk and microtoroid cavities, given the simplicity of the modification that only requires covering any light exposure inside the $XeF_2$ etching chamber.