

I. Cleaning the SiNx support film

Overall plasma cleaning is only useful to remove organic material that has typically physisorbed on the SiNx support. As a result, only carbon-based materials (i.e. Graphene, Carbon Nanotube, hydrocarbons, etc). At the same time, the treatment will result in the surface activation of the support film, which results in more favorable surface energy. Therefore, when it comes to metallic particles it will not be possible to etch them away in simple plasma. That doesn't mean that plasma cannot etch away metallic particles in general, but in order to do that, you need much more aggressive conditions (chlorine chemistry, high powers, high flows) which would result in the destruction of the thin film. Therefore, plasma cleaning is unfortunately not an option to remove that type of contamination. However, the customer can dip the chips in nitric acid (HNO₃) which would certainly remove away all type of contamination. And in that case, I would recommend dipping in HNO₃ with a concentration of 69% as this is known to effectively remove all metallic ions and particles. Be aware that HNO₃ is not a typical/standard chemical that everyone stores in their cabinets, but normally it would be very easy to find it inside cleanrooms or with people from the chemistry department.

II. Lifetime of the chips

Indeed the chips have got long lifetimes of 90 hours. That is something that has been extensively tested. And by this we mean that the MEMS device can perform as many heating experiments as the customer wants (heating and quenching, of course within the temperature range that we have specified) without suffering morphological and/or electrical changes that would result in the microheater's failure. However, re-using the same chip with different samples and still hoping to prevent cross-contamination, will very much depend on the nature of the sample used. As I mentioned, if the sample involves metal nanoparticles or any inorganic material, then the best way to clean them would be by dipping in HNO₃, but if the customer has been simply using organic materials, then plasma cleaning would be enough. For either case, these would be my recommendations:

- 1- Removing metallic/inorganic contamination
 - a) HNO₃ 99% - 5 minutes

b) Rinse in demi water until you reach 5MΩ of resistance (if you cannot measure resistance, then leave the water running for at least 2-3 minutes)

c) HNO₃ 69% - 10 minutes

d) Rinse in demi water again

2- Removing organic contamination requires plasma cleaning with the following parameters:

a) Oxygen plasma with power <10Watts

b) Flow: 5sccm

c) Time: 2-3 minutes