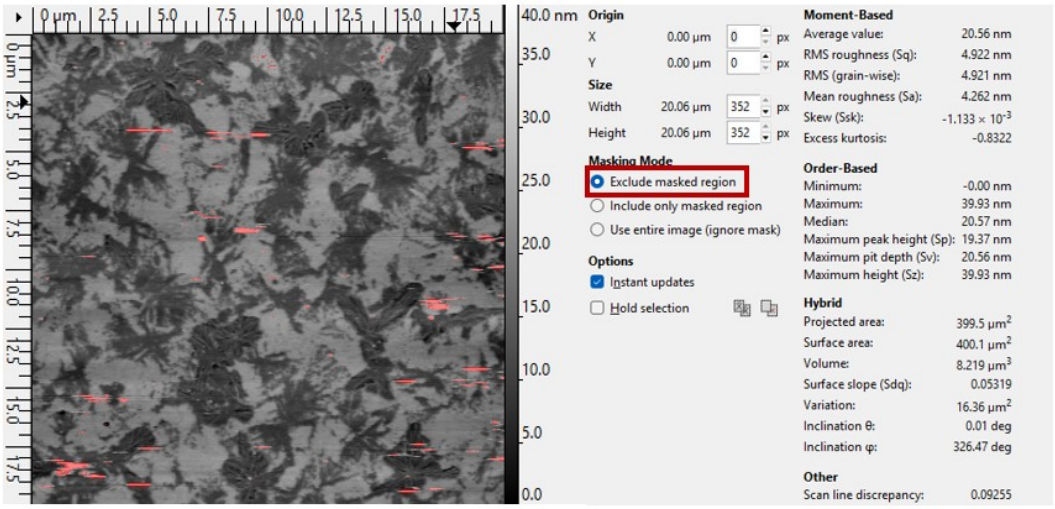
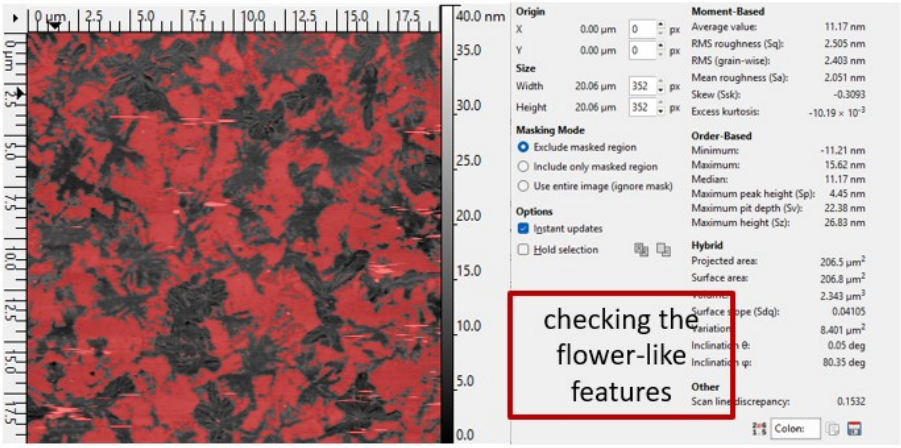
20 min sample

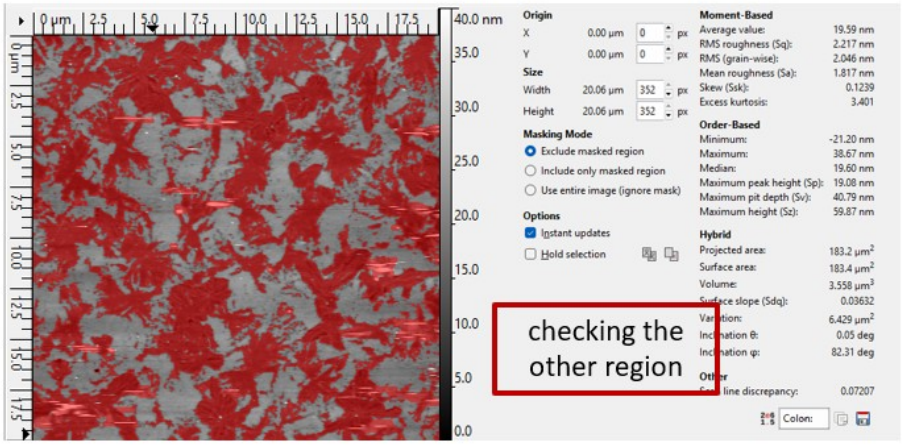
Flower-like structures are already visible on the surface before any correction. These areas have quite different z-values than the surroundings, making the film surface quite rough (about 4.5 nm).

However, if you consider only these two different regions you can observe that their roughness is relatively similar (about 2.2 - 2.5 nm depending on the region).

What are these features? Given their flower-like shape, with elongated grains, they are likely nucleation points forming during film deposition.

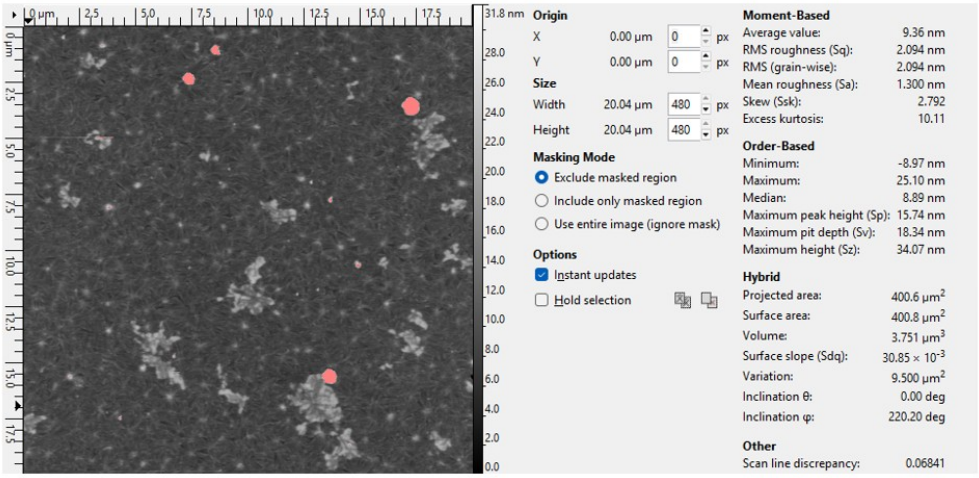




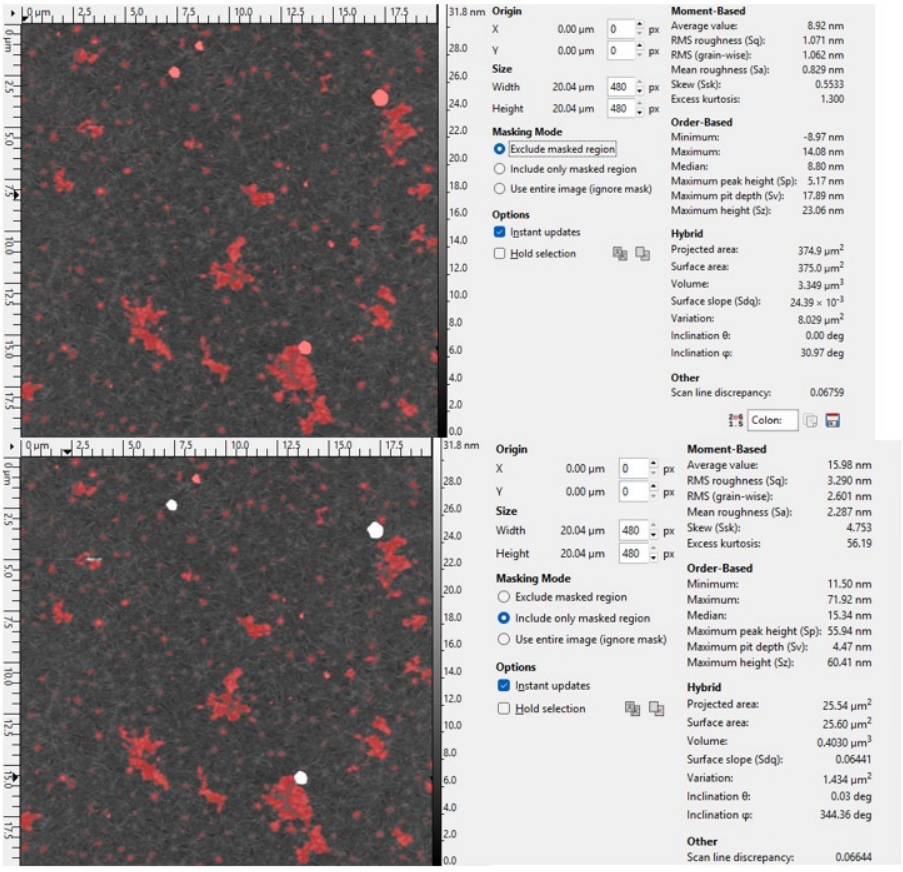


10 min sample

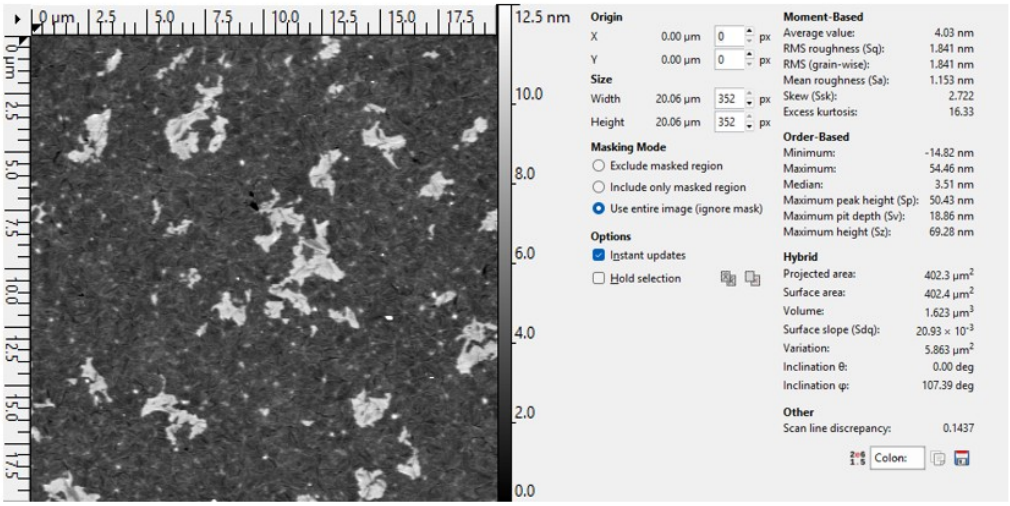
The grain structure of the sample is clearer here. The flower-like structures appear homogeneously distributed on the surface. They can be recognized by the presence of a thicker point in the center and regions with lower z-values in the surrounding, following the “petals” of the flower. Presence of inclusions with higher z-values can be recognized (light gray regions). Rather than nucleation points, they are more likely a secondary phase. They are present also in the samples deposited for less time. They could also be few over-oxidized areas on the surface, that we can remove dipping the sample in a dedicated bath (BHF for example).



Again, we can check the difference in roughness between the two regions of the sample. A noticeable difference can be observed between the main surface (about 1 nm) and the inclusions (about 3 nm).

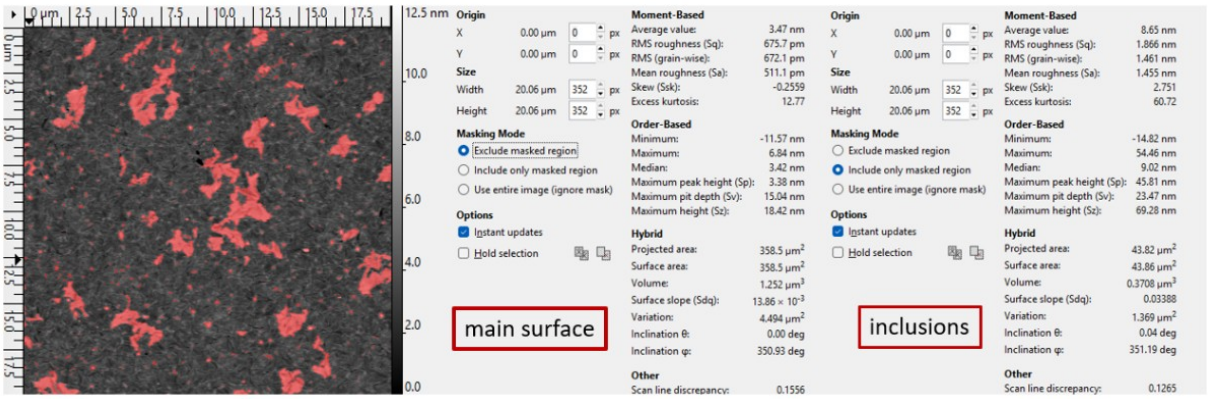


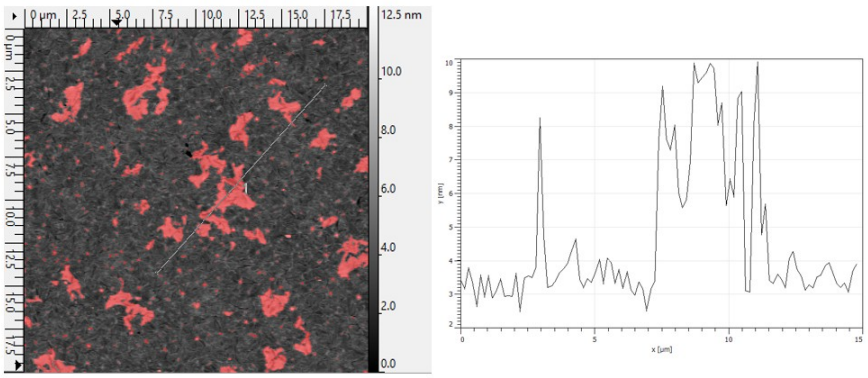
5 min sample



Note that in this sample it's pretty evident we have to apply a double correction: we take into account the void a particle on the surface and we correct for the horizontal lines, adjusting the scale; we see appearing other horizontal lines, so we mask the inclusions and again we apply the correction. Now the image is lines-free!

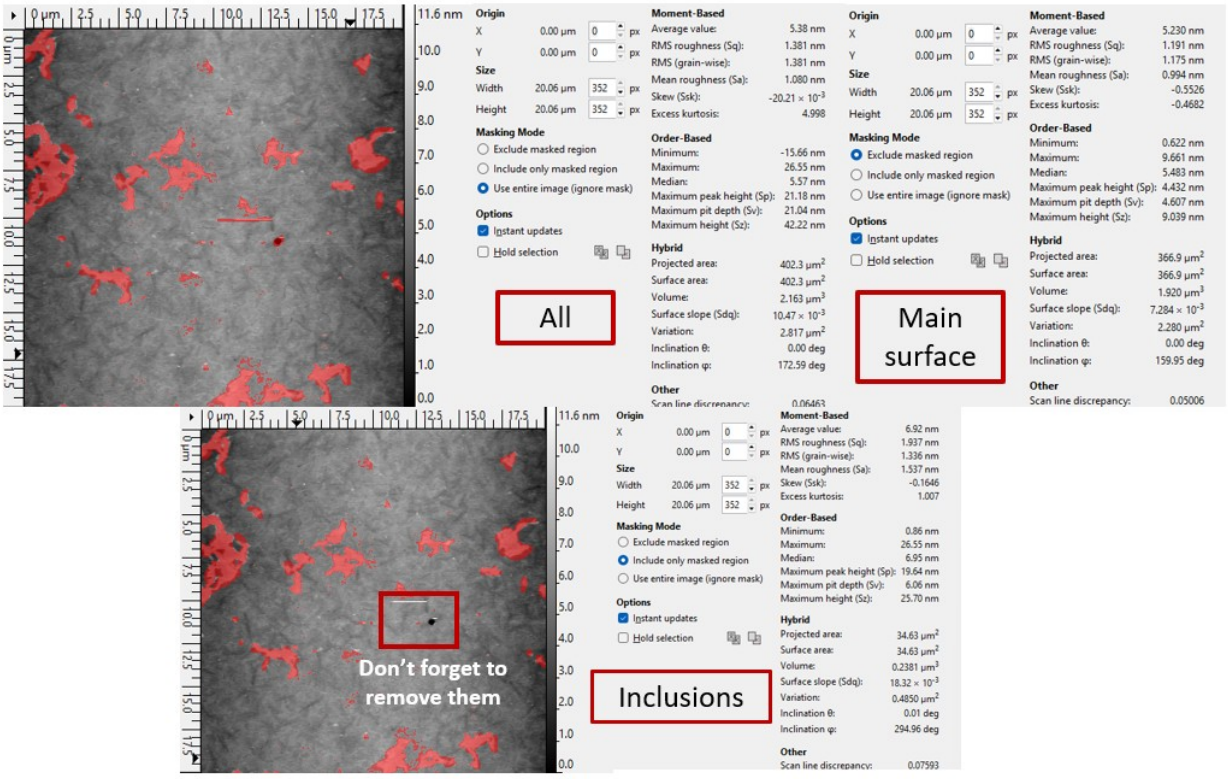
Let's see how the presence of the inclusions impact the roughness in this sample:





The difference is important, in fact on average the inclusions are about three times rougher than the rest of the surface. This point must be kept in mind if you plan to exploit the film to make a device!

2.5 min sample



In this case the difference in roughness between the main surface and the inclusions is less important.

If we consider the average roughness of the samples as deposited, we can see that roughness tends to increase with the deposition time (therefore film thickness).