Anexo 3

Spray Coating Results

SEM Images and Thickness graphics

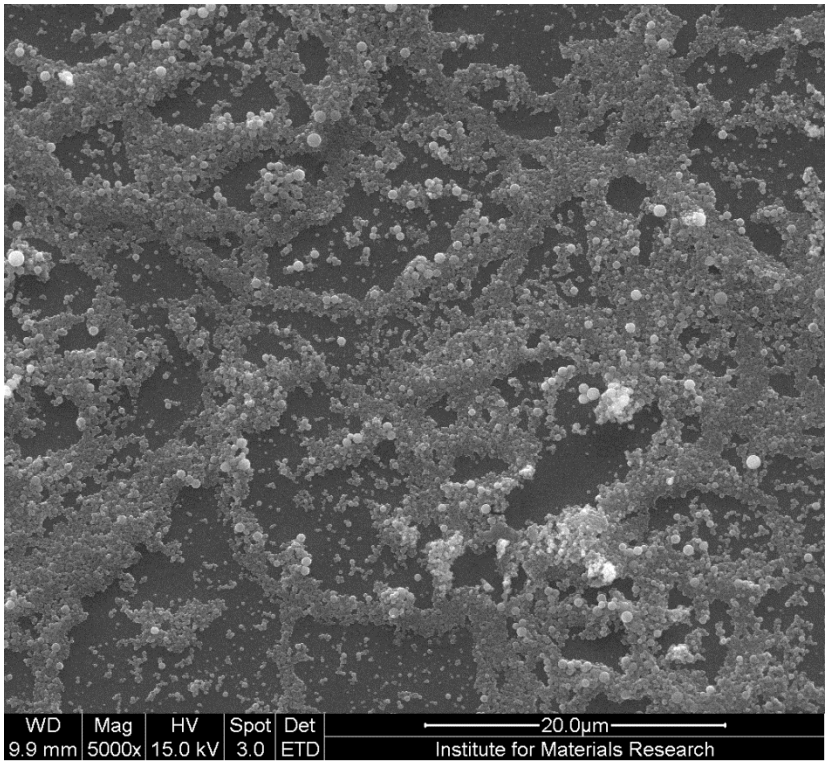
SEM IMAGES

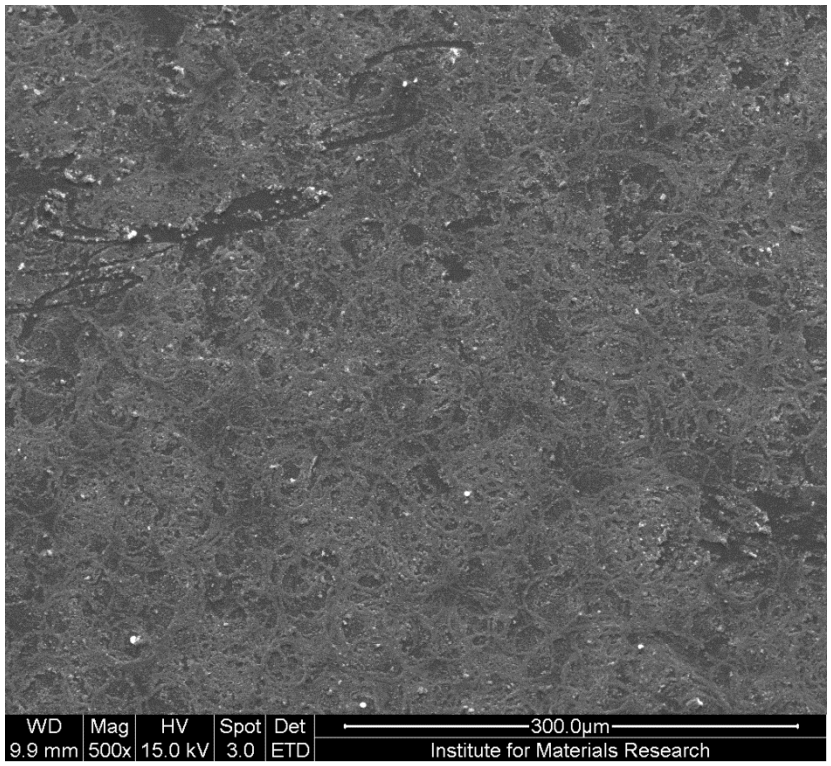
First Printing

First Printing – 1 pass

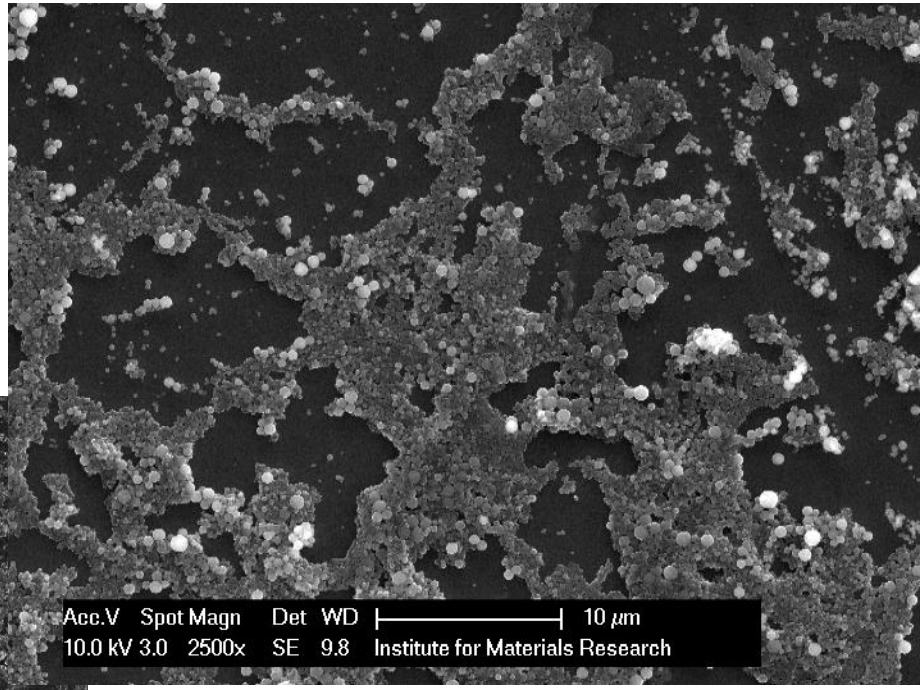
- In this first printing, we did SEM to the best samples with just one pass. The results were good comparing to the beginning of the experiments but it was still possible to see the rolls on the layer.

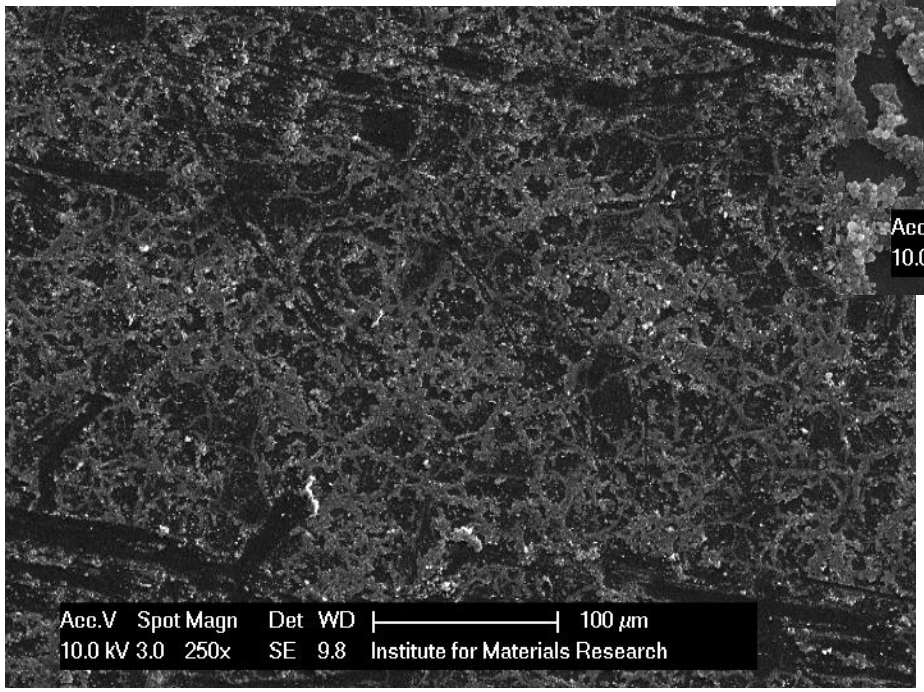
First Printing – 30% ethanol, washed, 80°C, 0.2 ml/min, 1 pass, 2,5 Watts



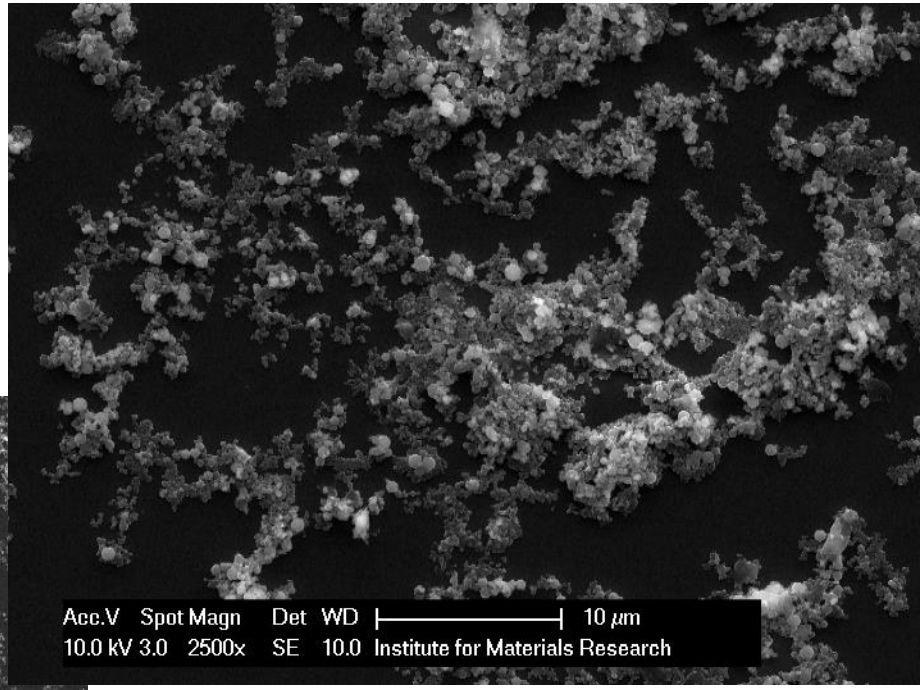


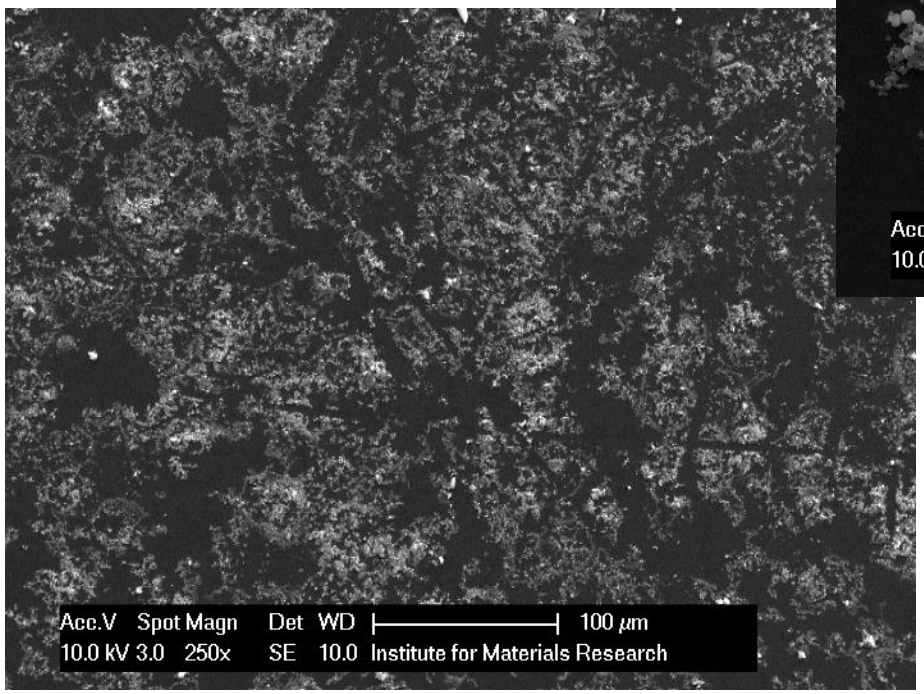
First Printing – 30% ethanol, not washed, 70°C, 0.2 ml/min, 1 pass, 2,5 Watts



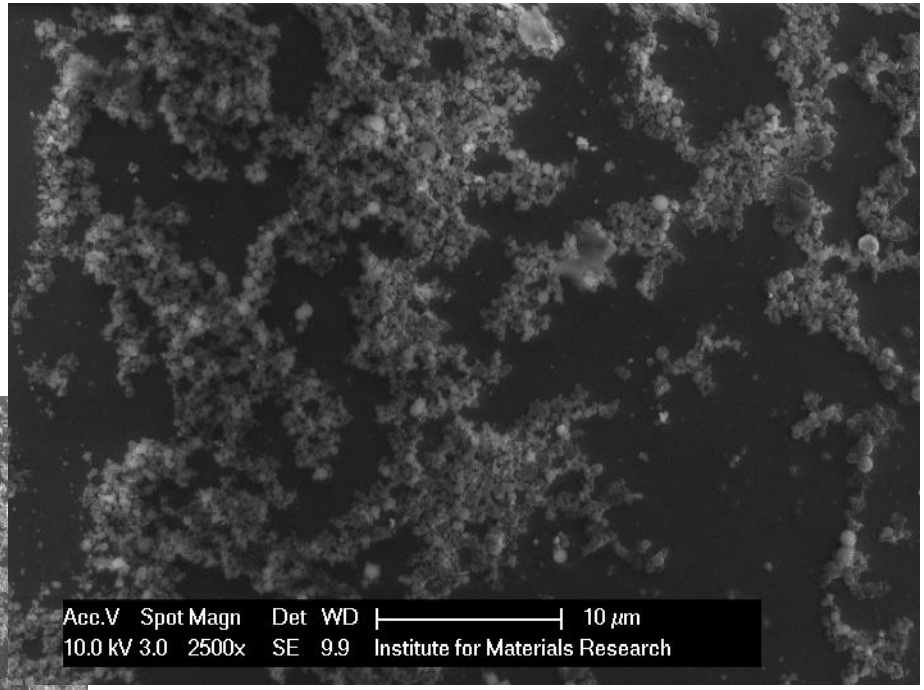


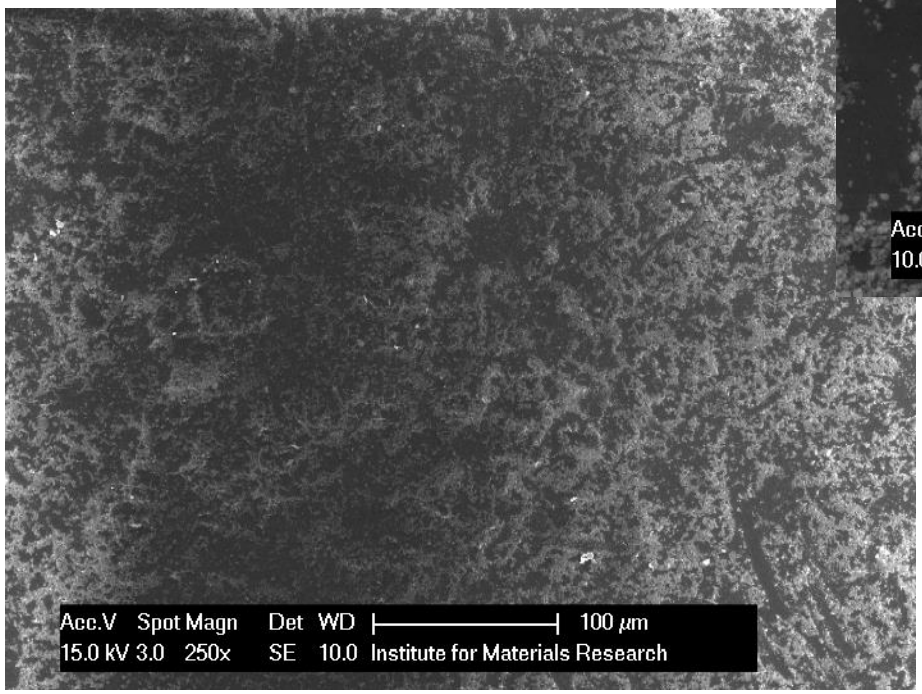
First Printing – 30% ethanol, not washed, 90°C, 0.2 ml/min, 1 pass, 4 Watts





First Printing – 70% ethanol, not washed, 60°C, 0.2 ml/min, 1 pass, 4 Watts





SEM IMAGES

Multi pass

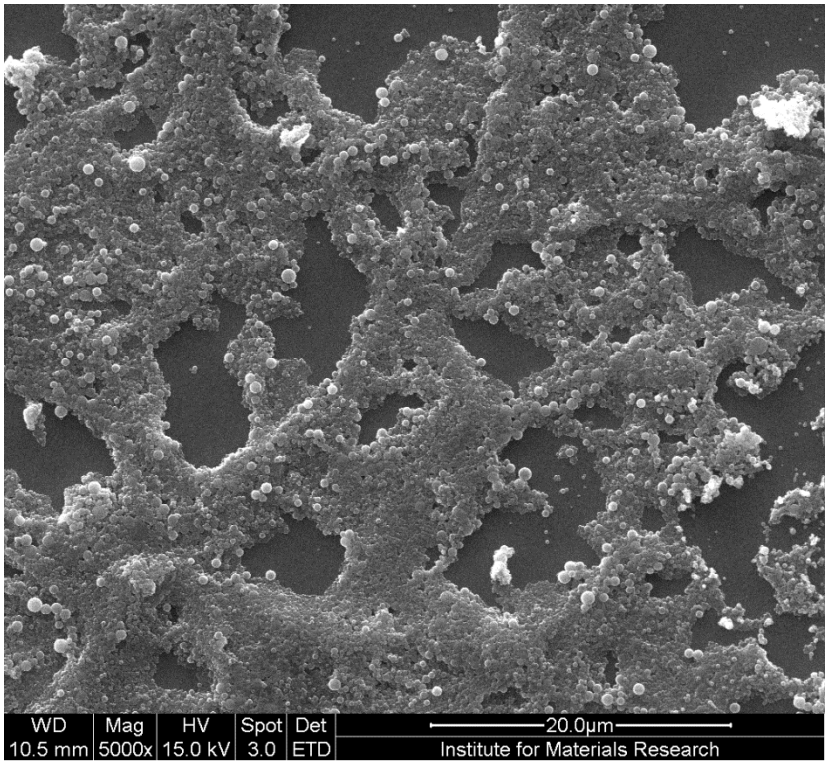
Multi pass printing

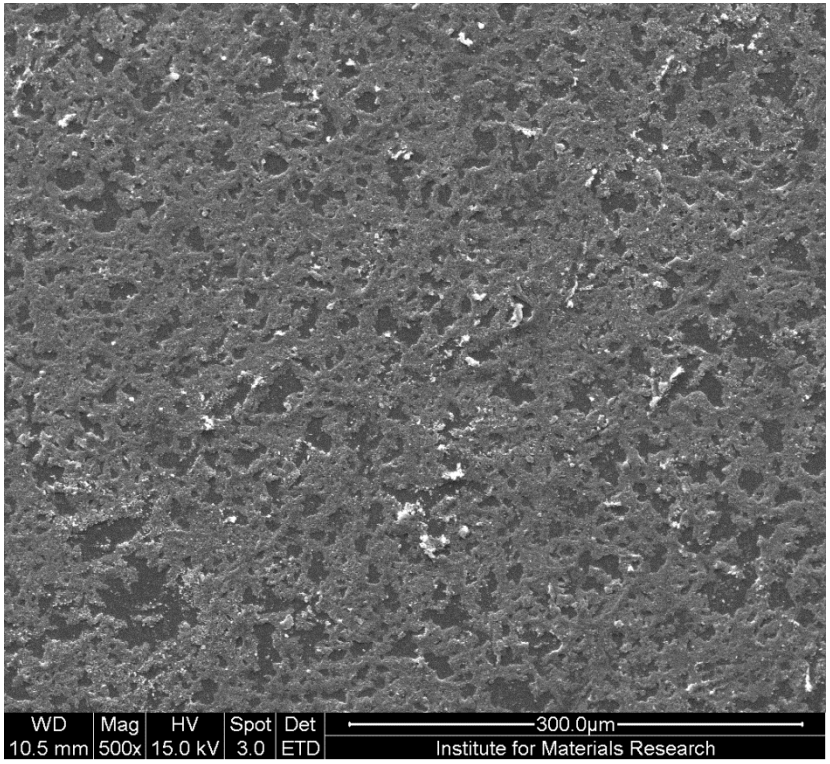
- So the next step was print with the multi pass technique.
- It was printed 1, 2, 3, 5 and 10 passes, in the plate temperature of 60°C, 70°C, 80°C and 90°C and the flow rate of 0,1 and 0,2 ml/min.
- All the samples that was made SEM images is in the following slides.
- We can conclude that the 5 and 10 passes have the best results, because it was formed a completely covered layer with the flow rate of 0.2 ml/min

Multi pass printing

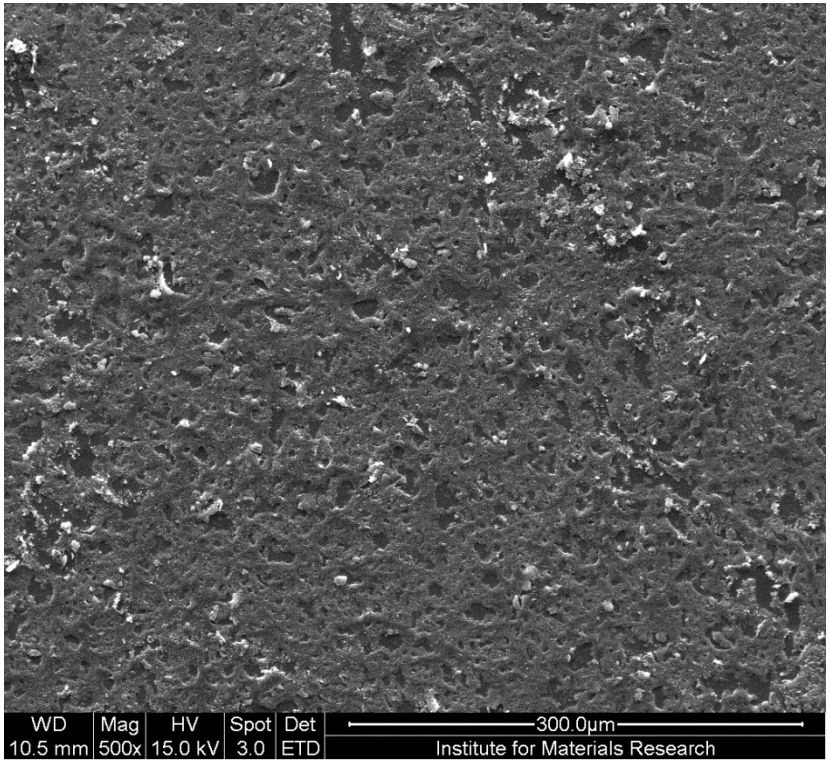
- The 0.1 ml/min samples still have some rolls, as we can see on the images.
- The 70% ethanol had better results than 30%. The layer was more completely without holes.
- We can’t see big differences between the different plate temperatures, they have similar results.

Multi pass – 30% ethanol, not washed, 60°C, 0.2 ml/min, 3 passes, 4 Watts

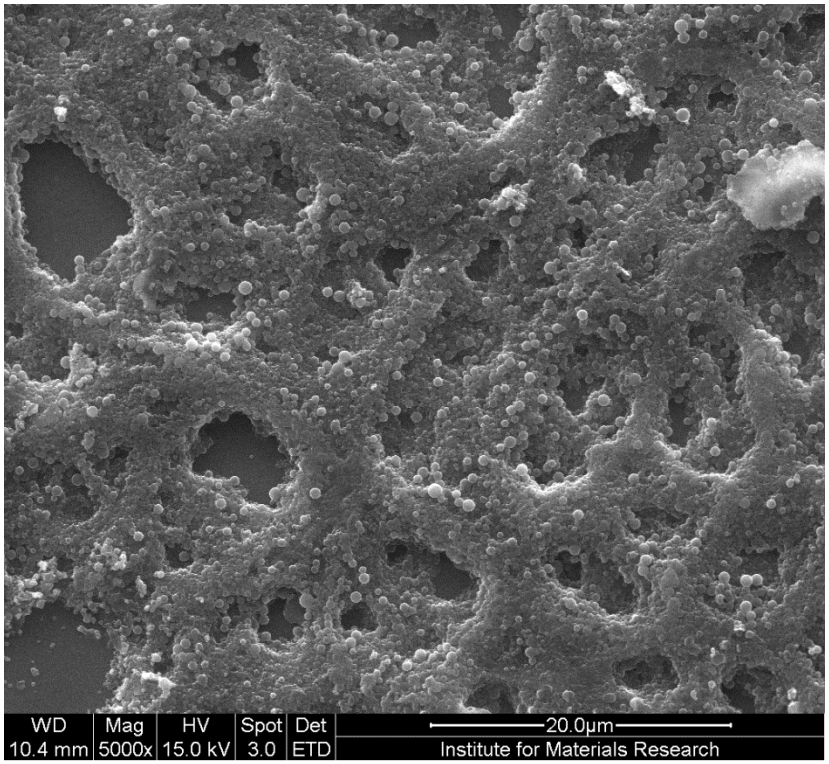


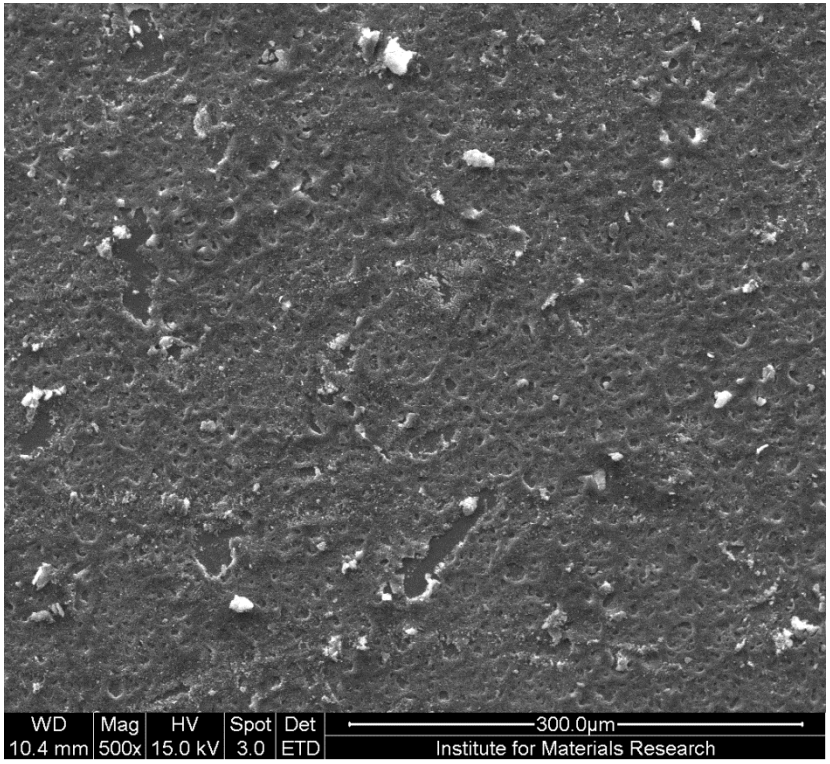


Multi pass – 30% ethanol, not washed, 60°C, 0.2 ml/min, 5 passes, 4 Watts

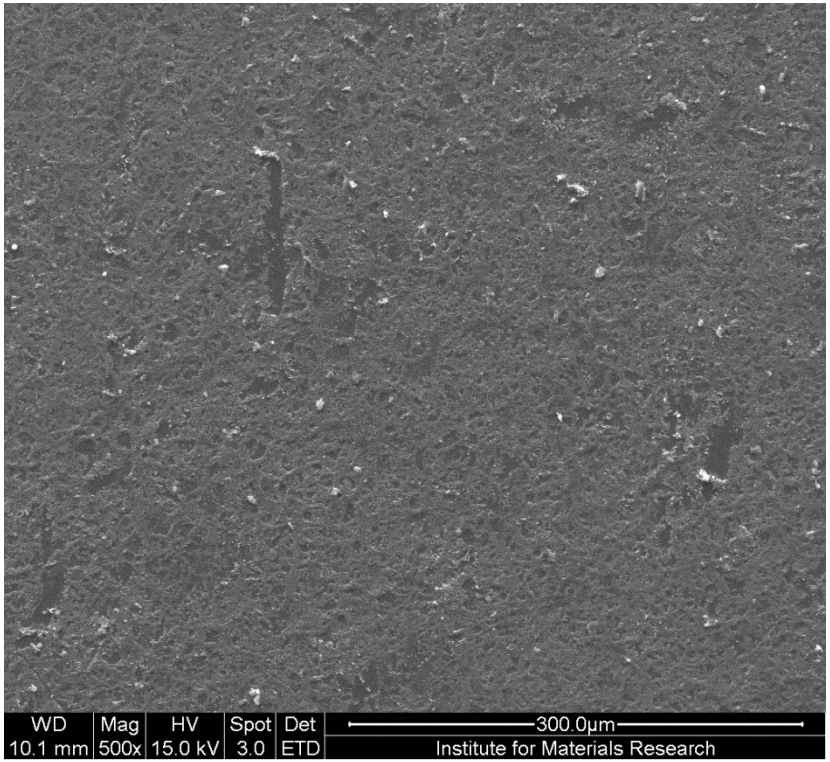


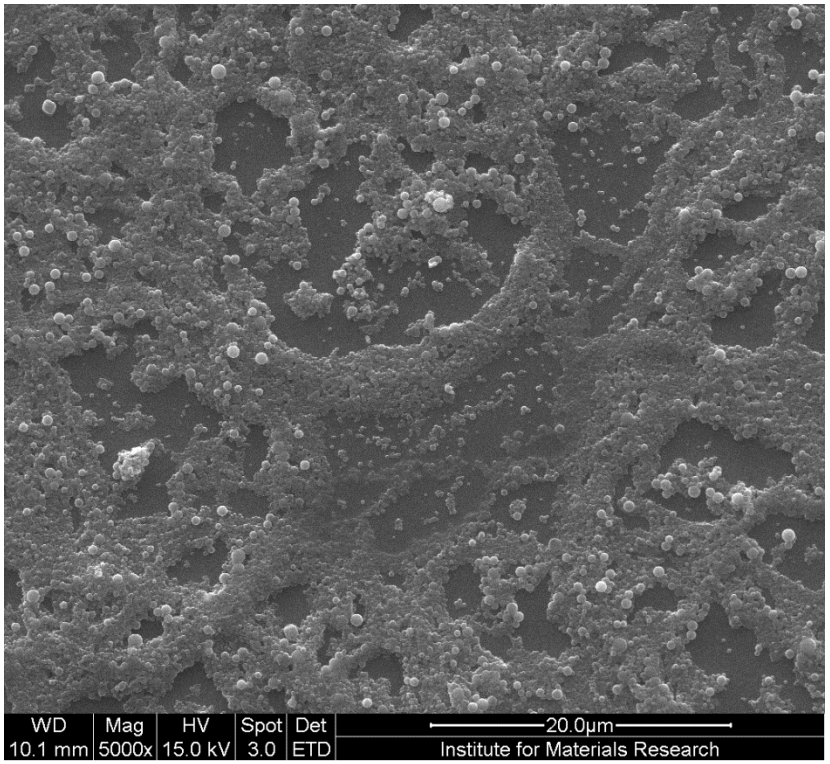
Multi pass – 30% ethanol, not washed, 60°C, 0.2 ml/min, 10 passes, 4 Watts



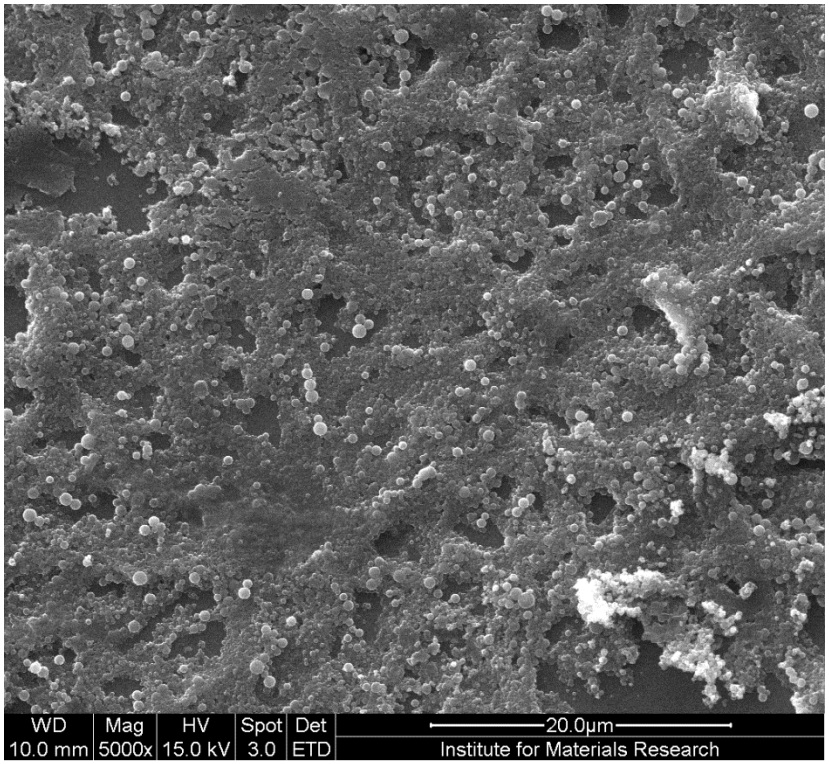


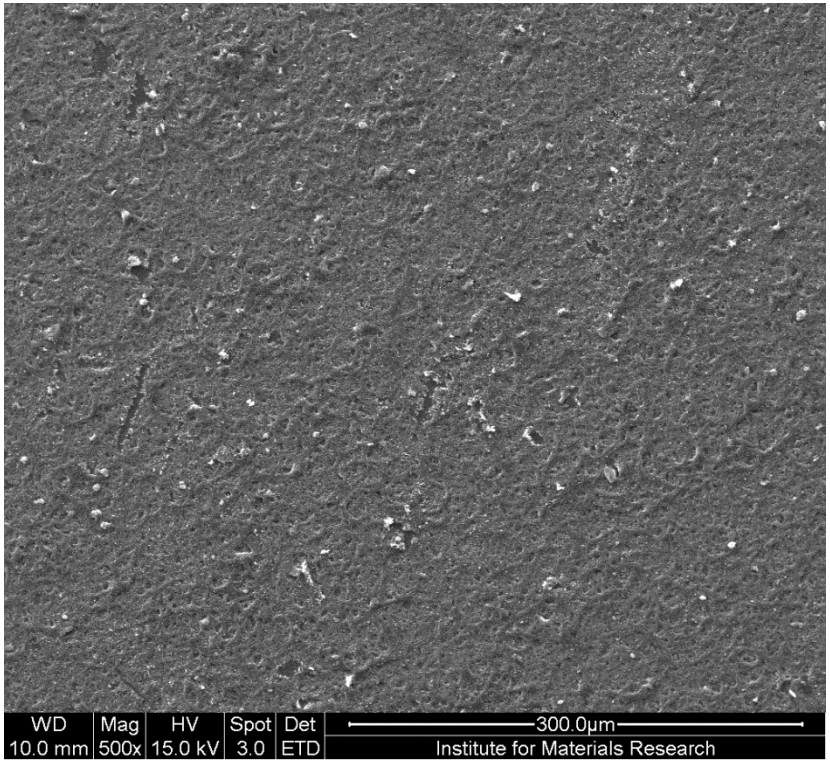
Multi pass – 30% ethanol, not washed, 90°C, 0.2 ml/min, 3 passes, 4 Watts



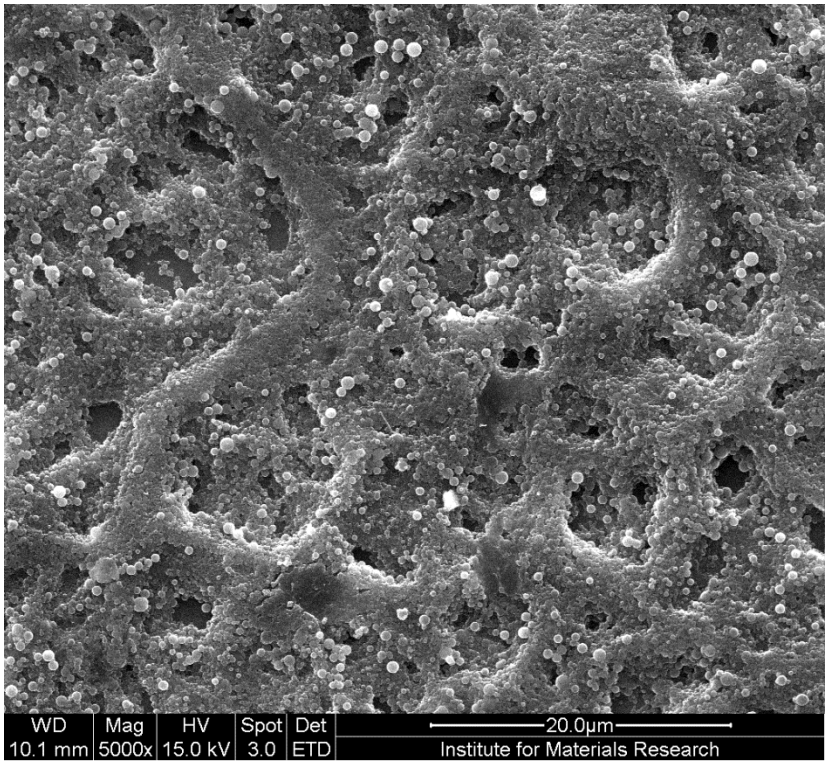


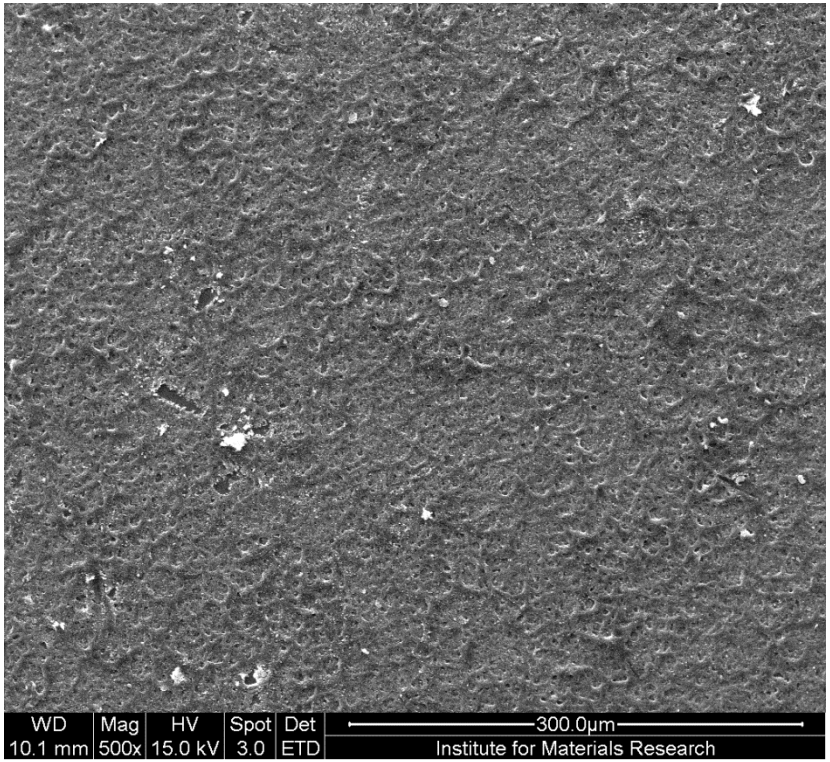
Multi pass – 30% ethanol, not washed, 90°C, 0.2 ml/min, 5 passes, 4 Watts



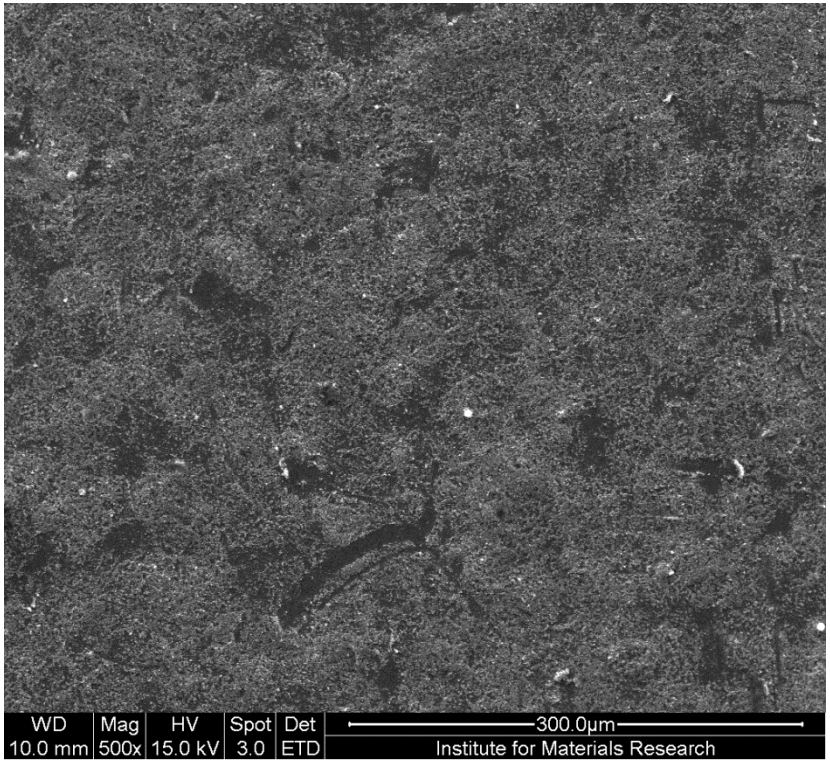


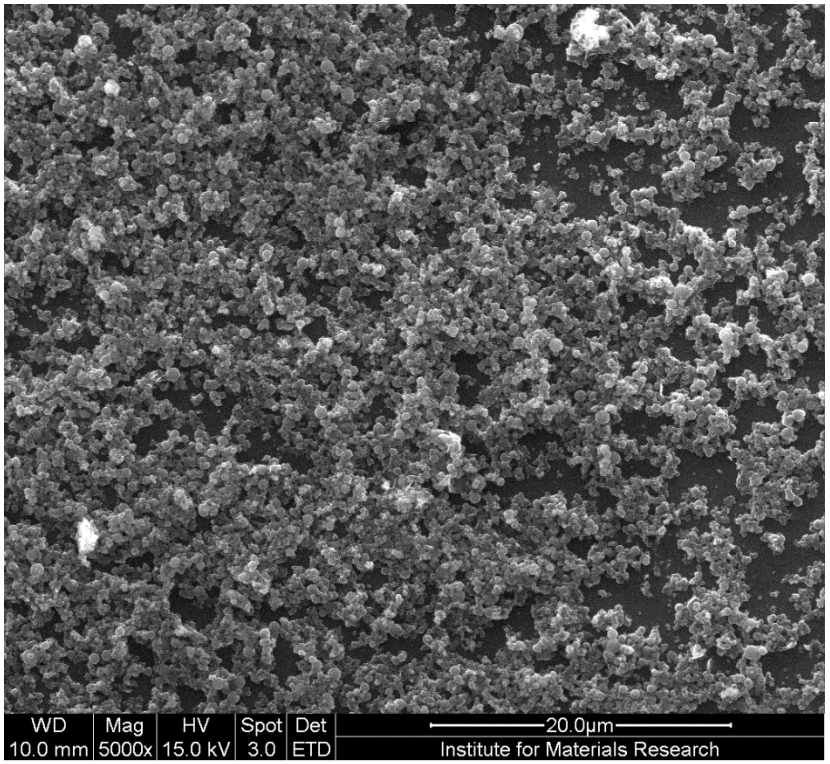
Multi pass – 30% ethanol, not washed, 90°C, 0.2 ml/min, 10 passes, 4 Watts



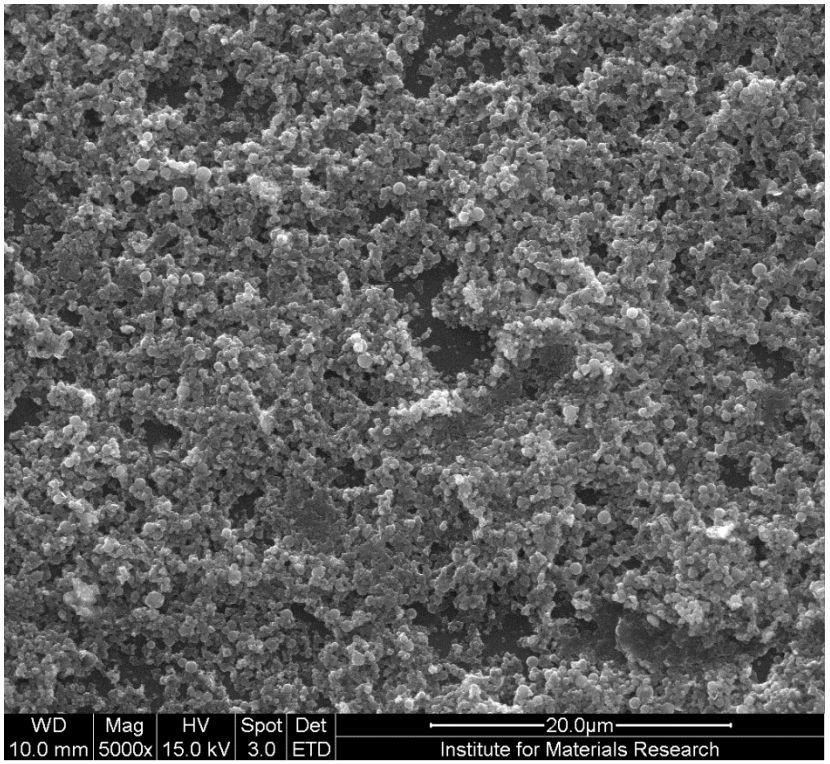


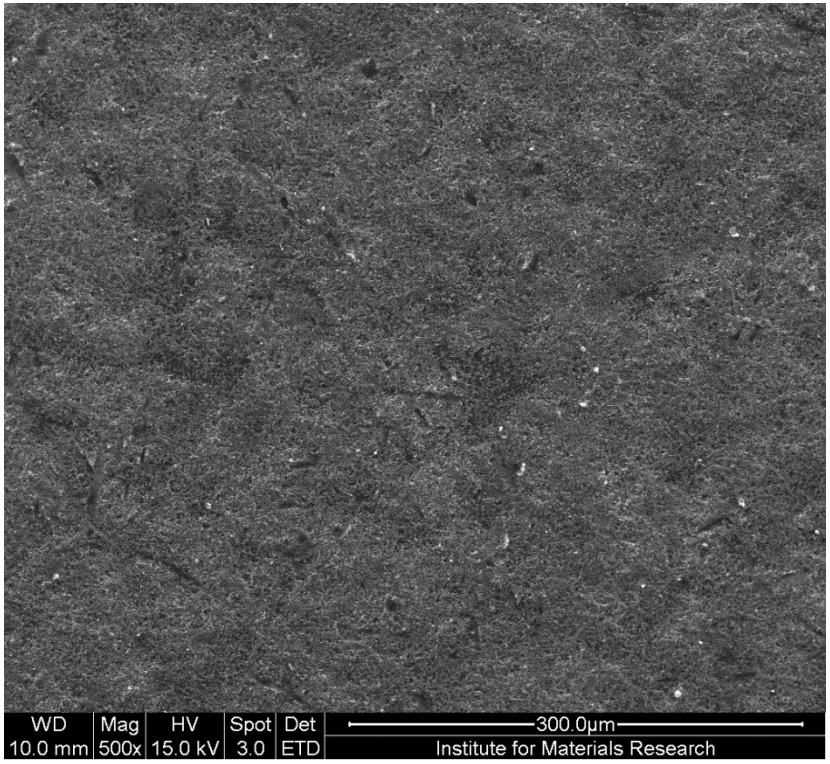
Multi pass – 70% ethanol, not washed, 60°C, 0.1 ml/min, 5 passes, 4 Watts



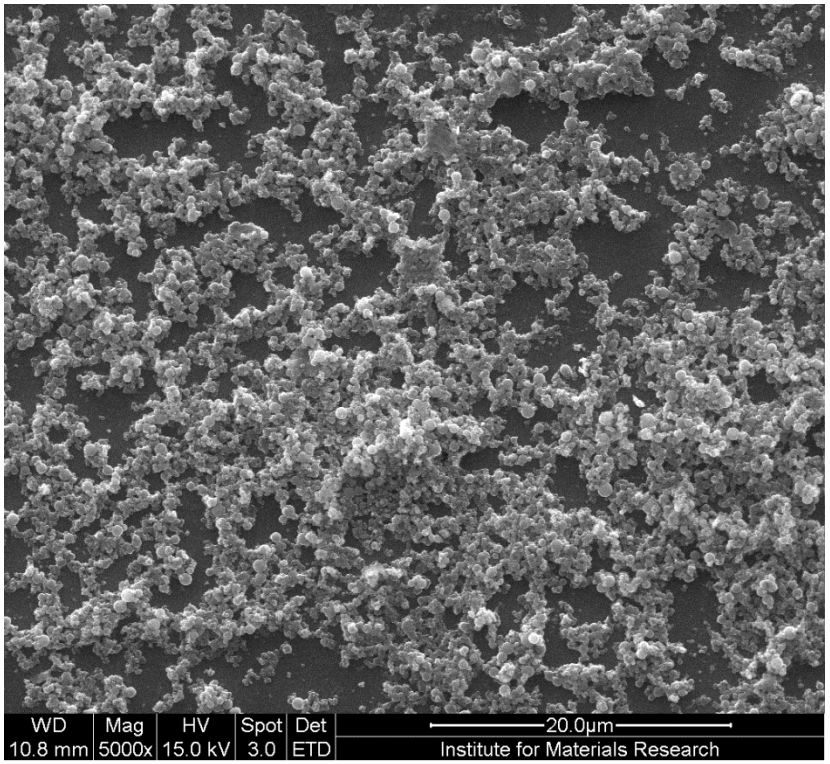


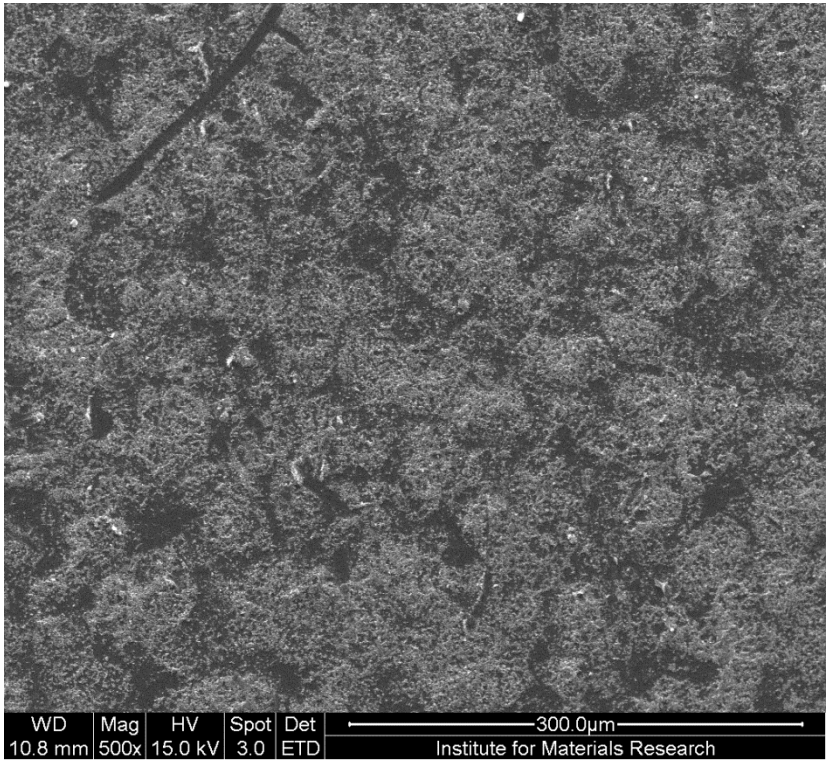
Multi pass – 70% ethanol, not washed, 60°C, 0.1 ml/min, 10 passes, 4 Watts



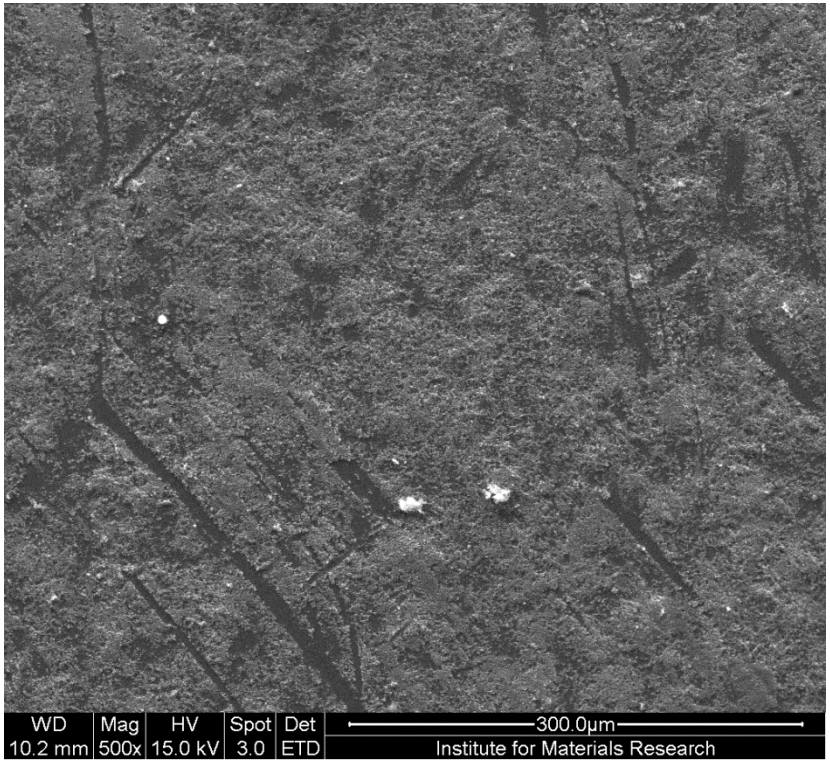


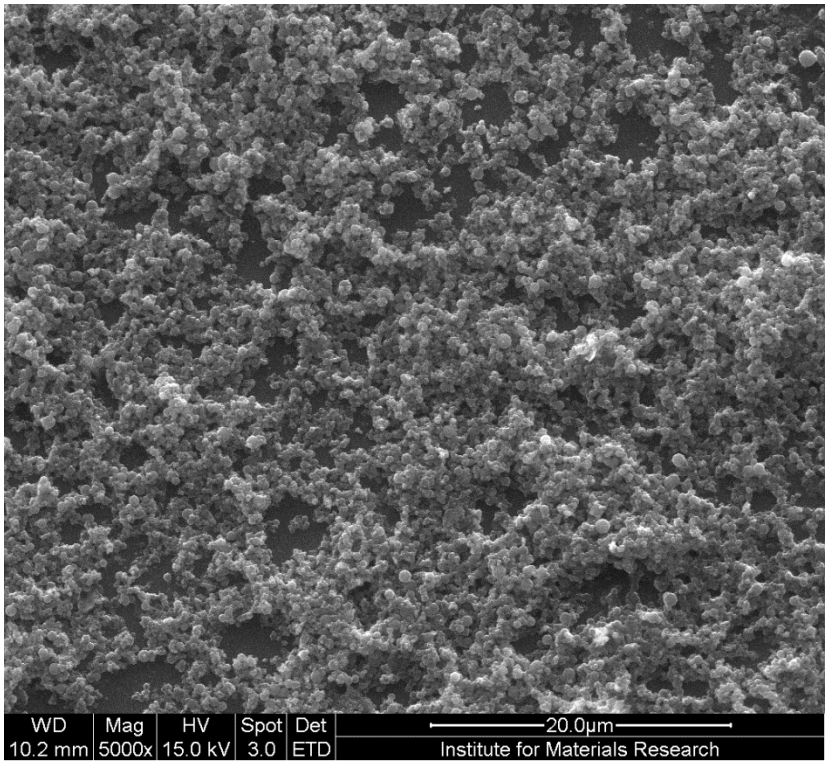
Multi pass – 70% ethanol, not washed, 90°C, 0.1 ml/min, 5 passes, 4 Watts



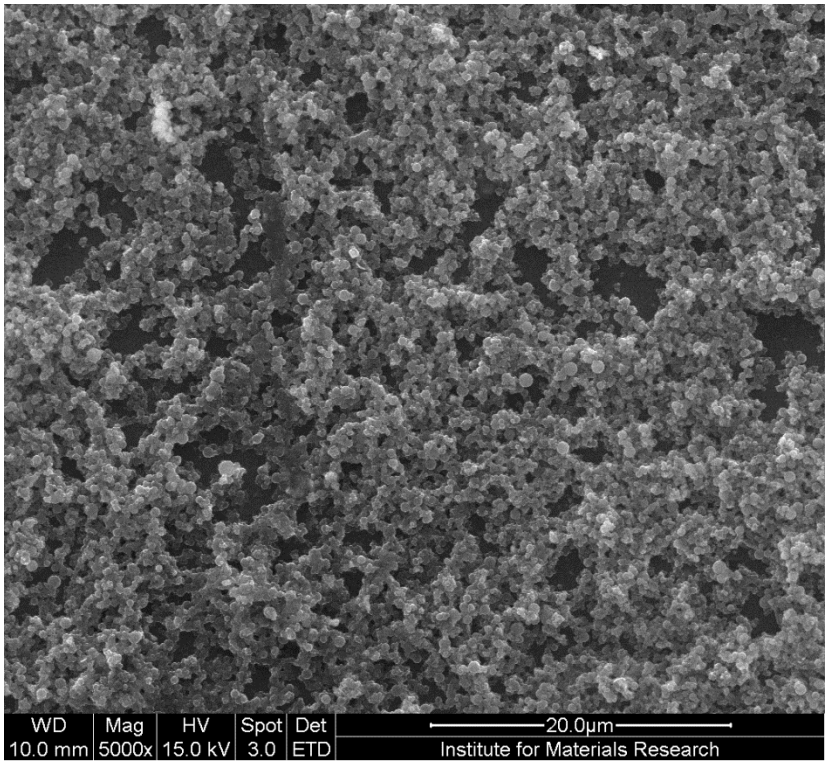


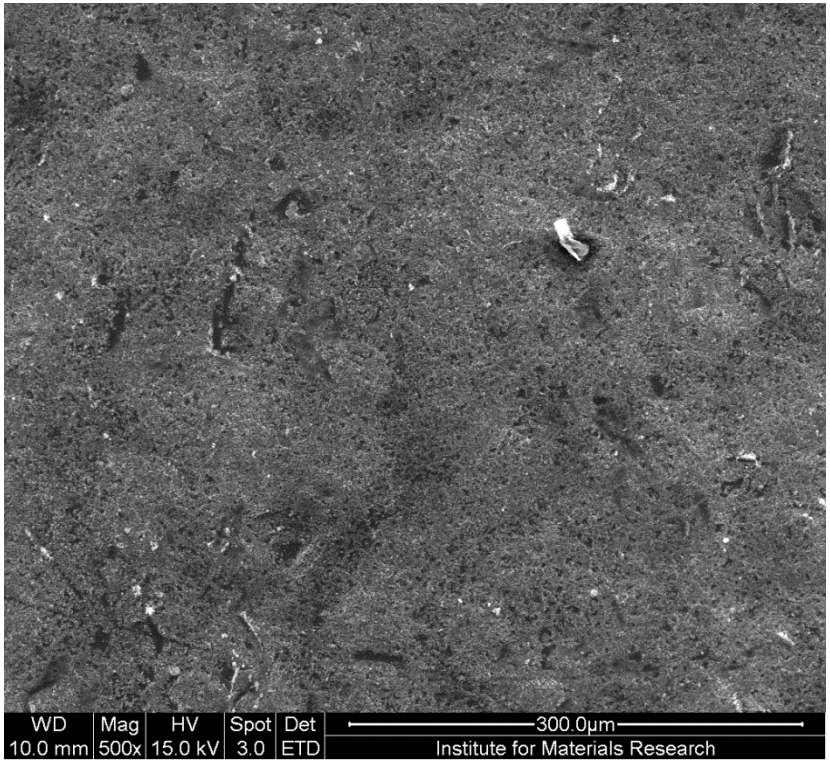
Multi pass – 70% ethanol, not washed, 90°C, 0.1 ml/min, 10 passes, 4 Watts



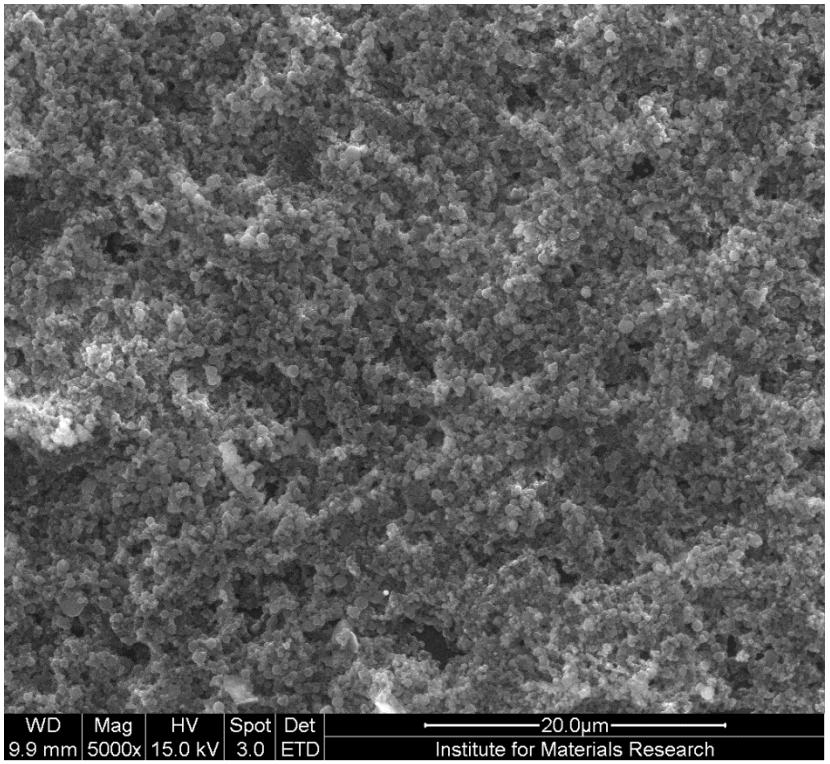


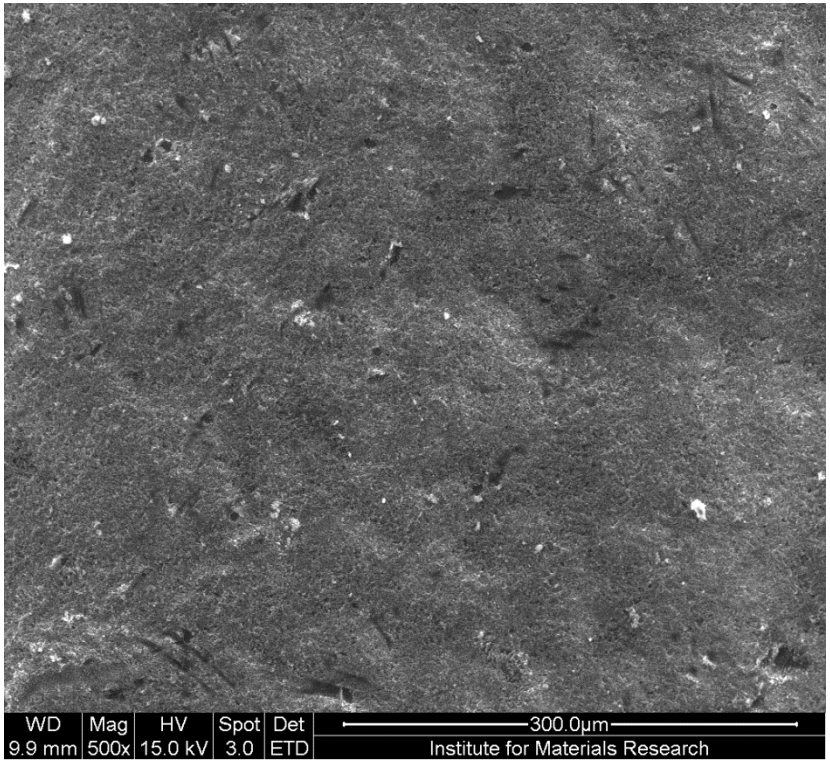
Multi pass – 70% ethanol, not washed, 60°C, 0.2 ml/min, 3 passes, 4 Watts



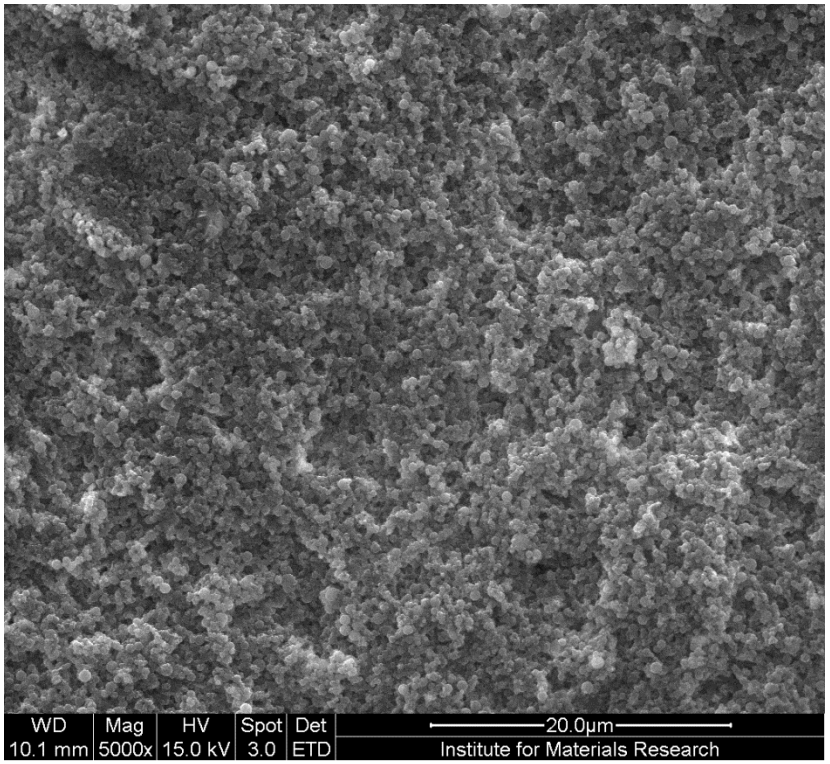


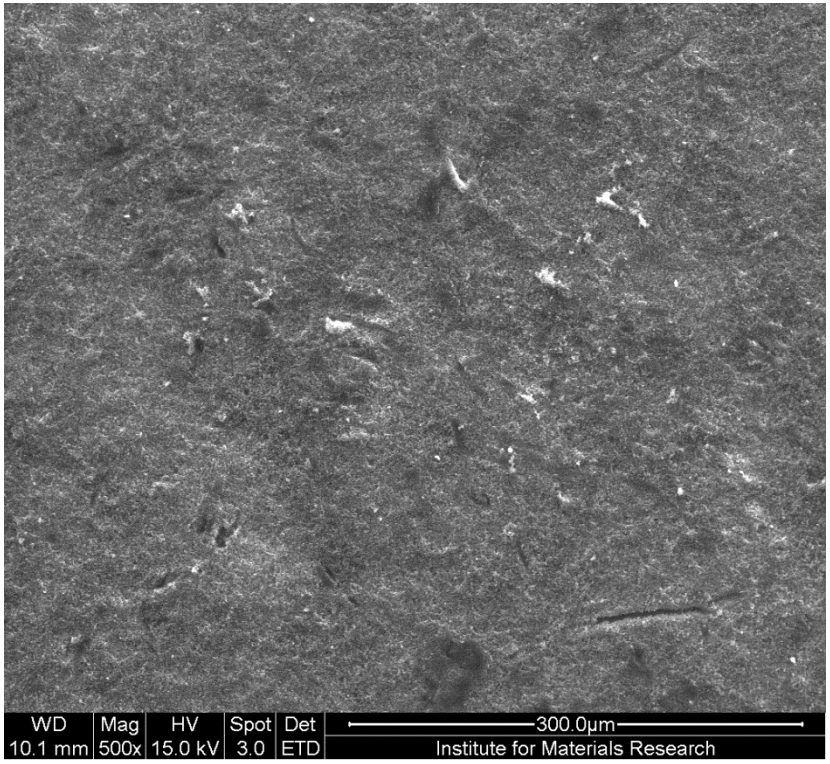
Multi pass – 70% ethanol, not washed, 60°C, 0.2 ml/min, 5 passes, 4 Watts



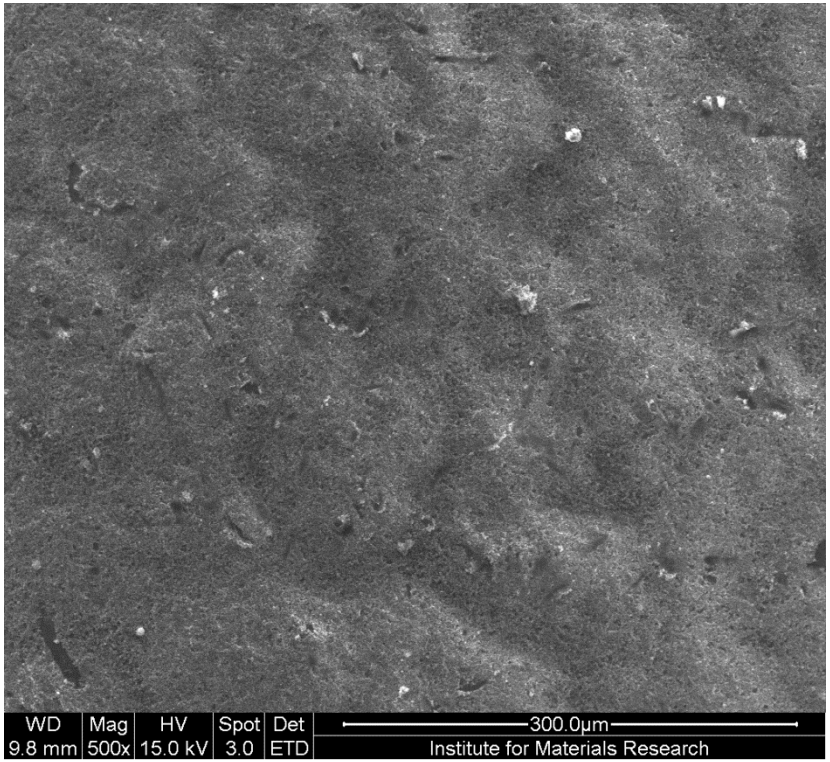


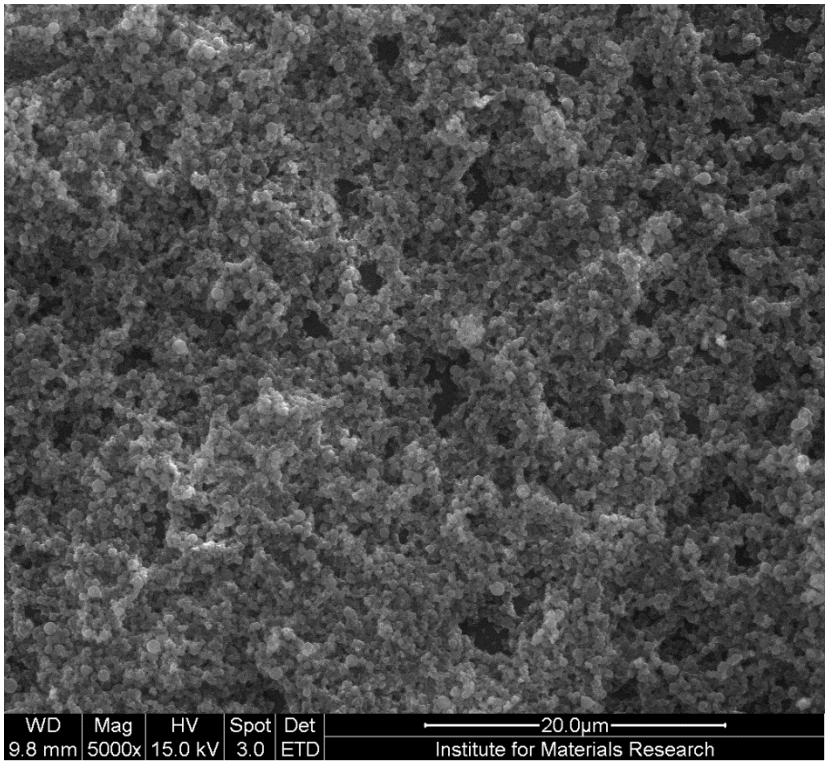
Multi pass – 70% ethanol, not washed, 60°C, 0.2 ml/min, 10 passes, 4 Watts



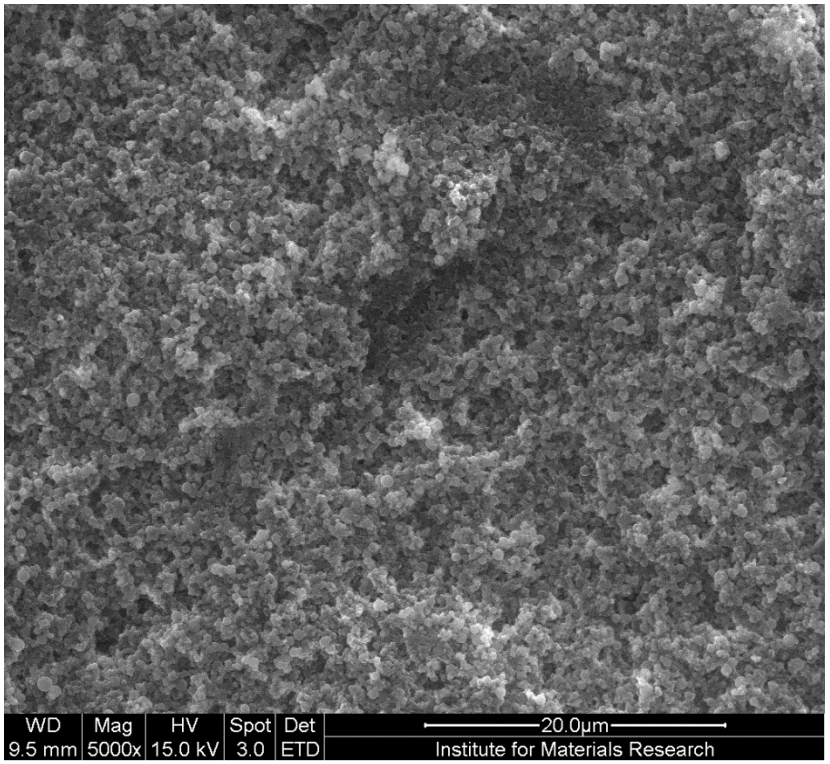


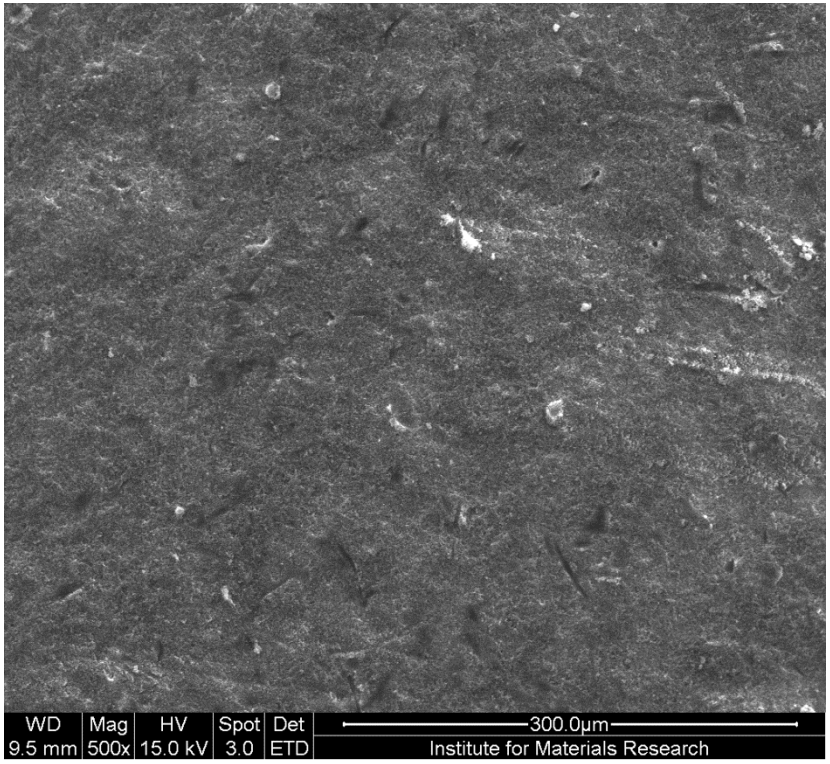
Multi pass – 70% ethanol, not washed, 70°C, 0.2 ml/min, 5 passes, 4 Watts



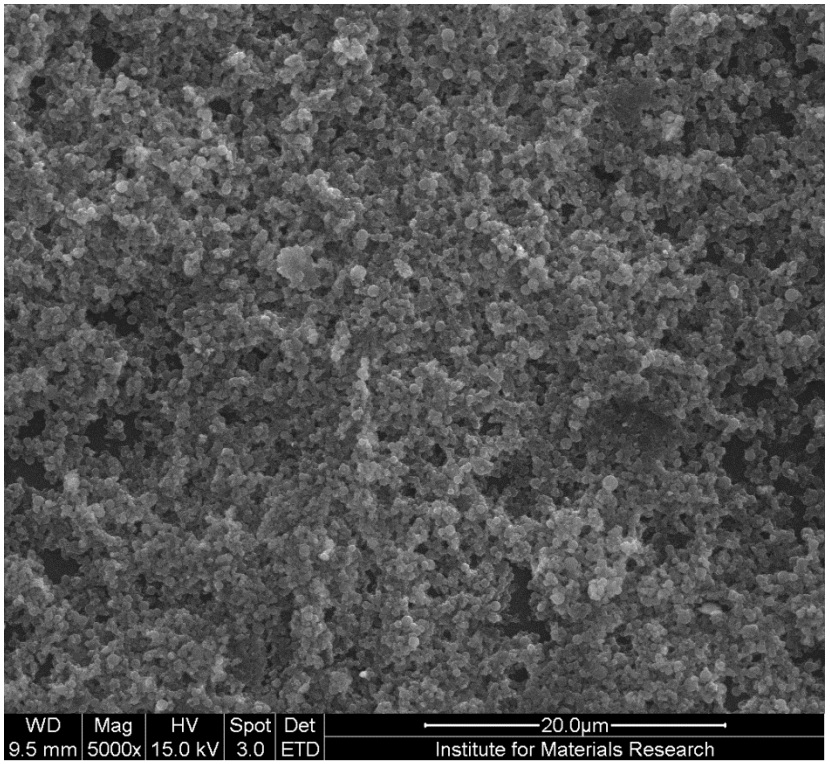


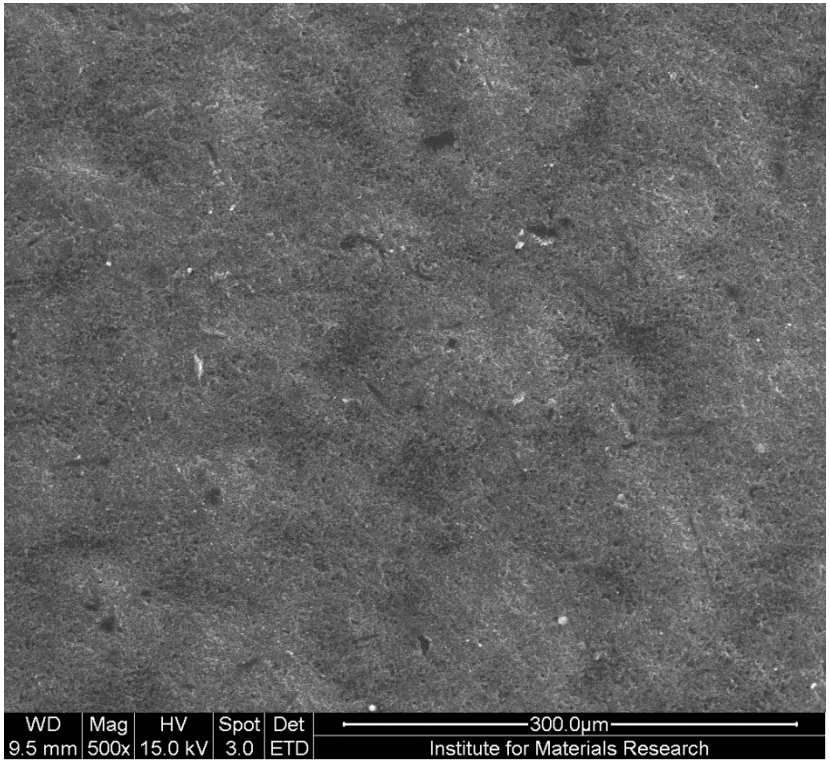
Multi pass – 70% ethanol, not washed, 70°C, 0.2 ml/min, 10 passes, 4 Watts



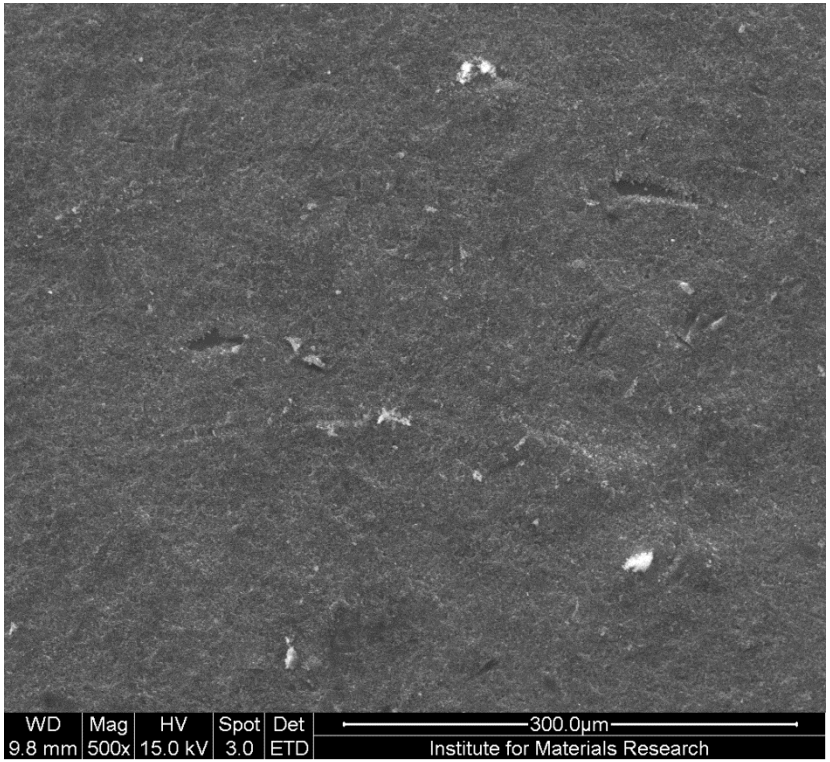


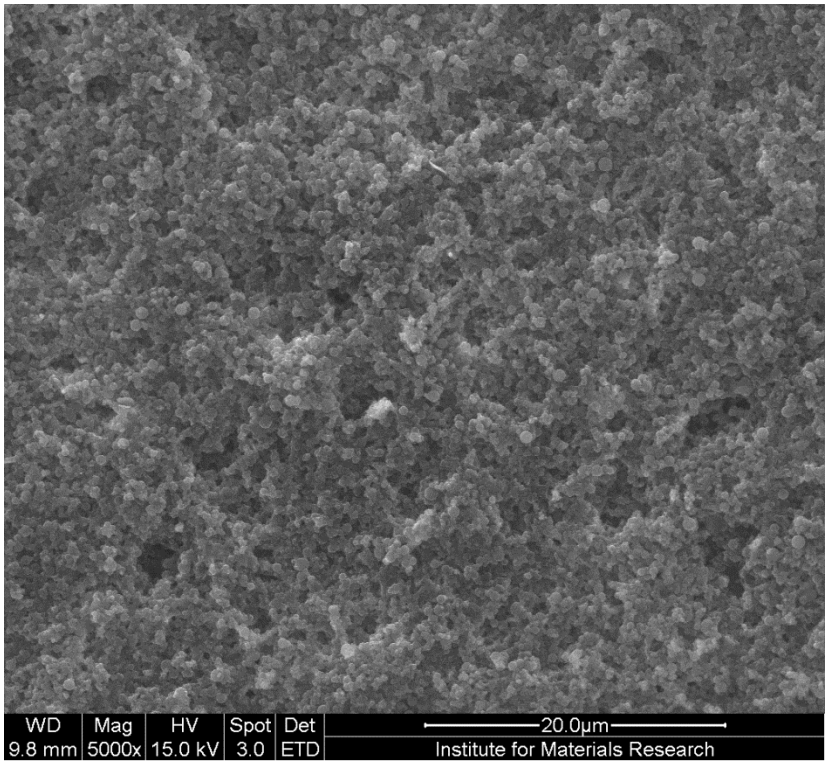
Multi pass – 70% ethanol, not washed, 80°C, 0.2 ml/min, 5 passes, 4 Watts



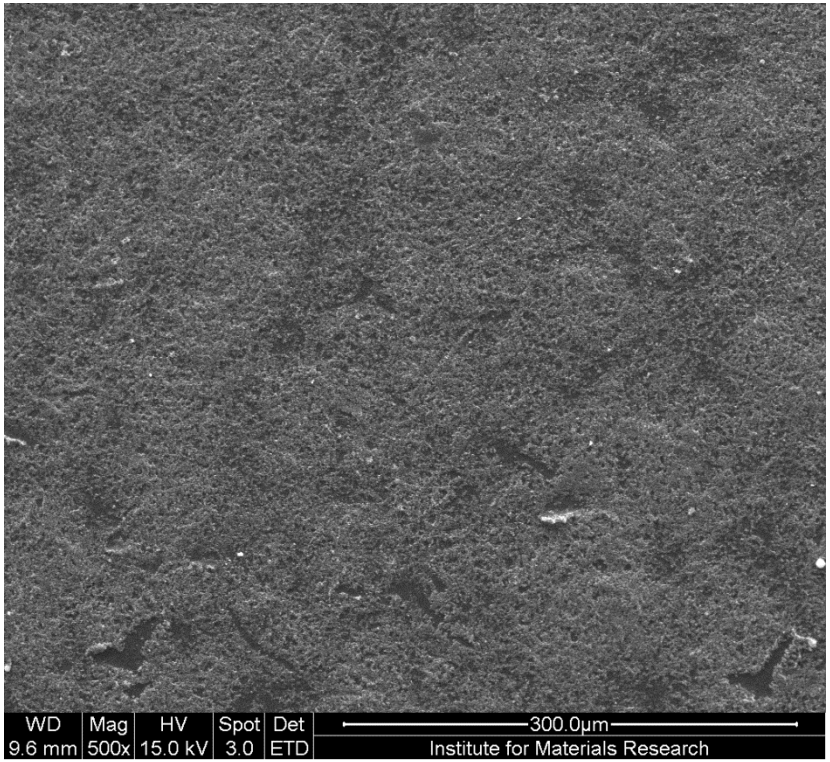


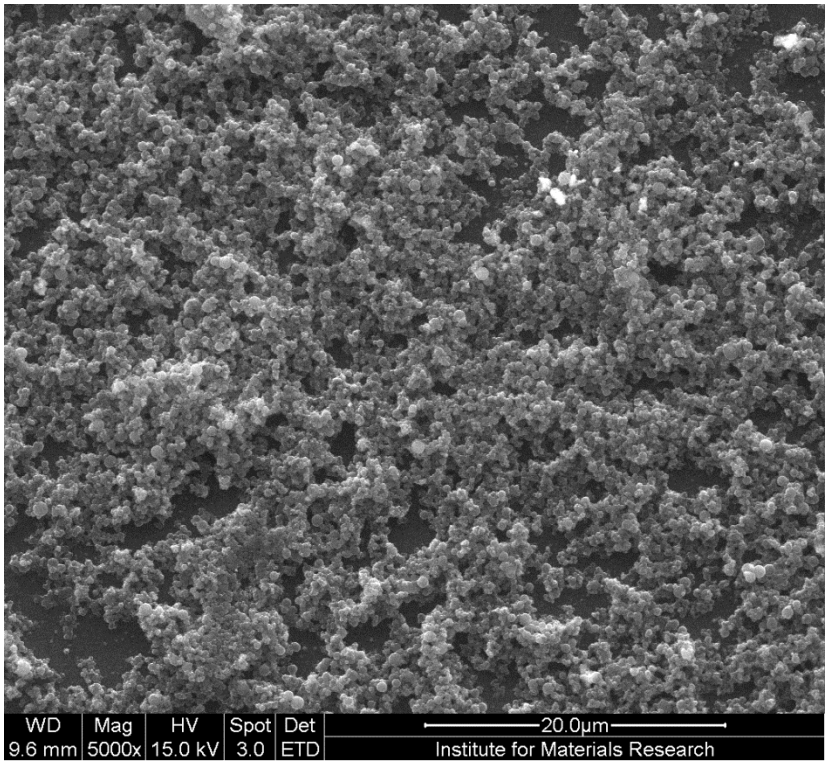
Multi pass – 70% ethanol, not washed, 80°C, 0.2 ml/min, 10 passes, 4 Watts



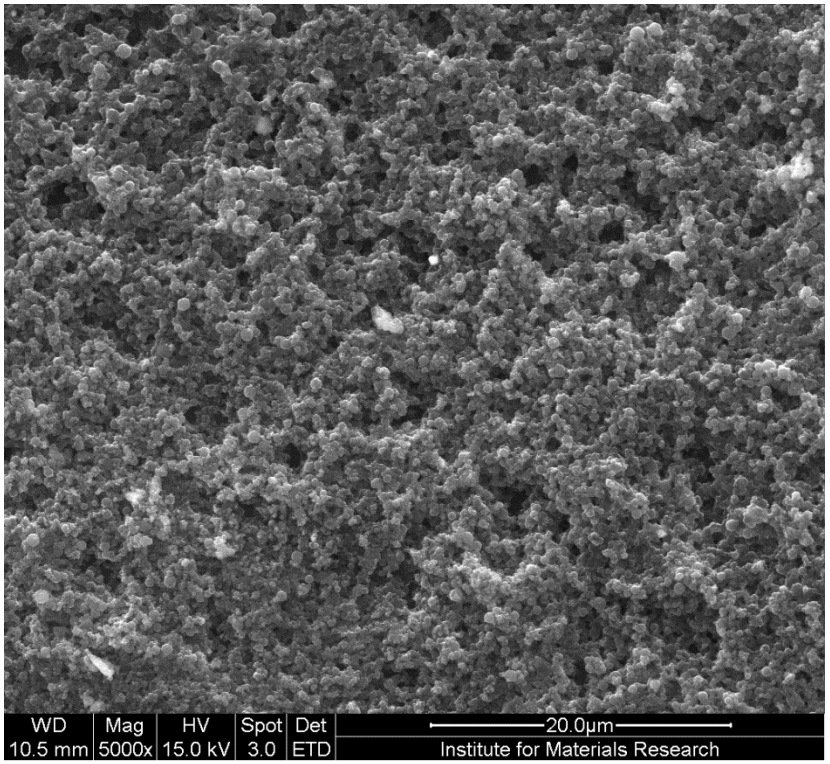


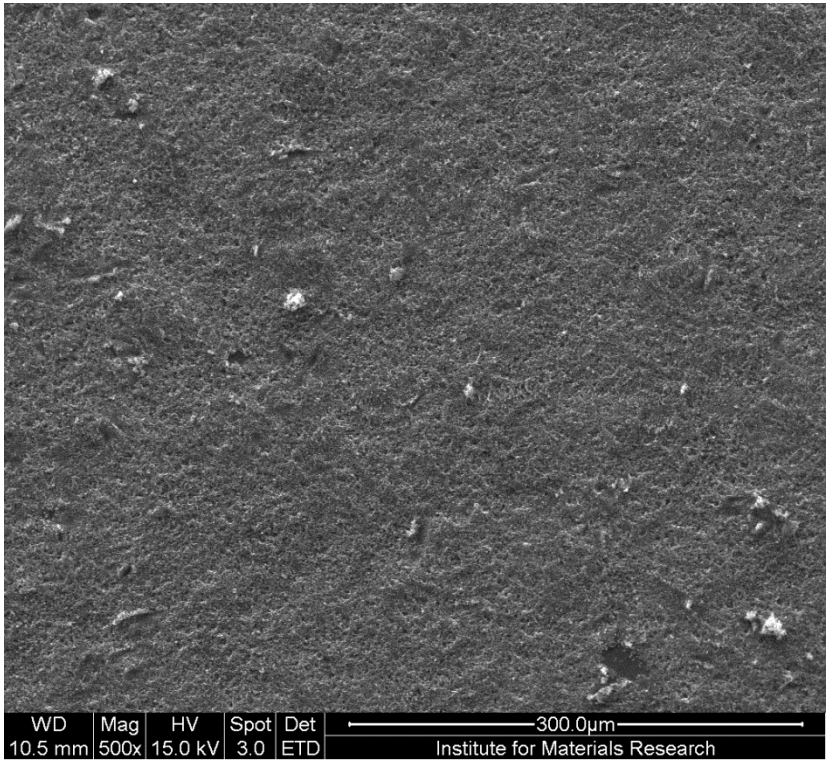
Multi pass – 70% ethanol, not washed, 90°C, 0.2 ml/min, 3 passes, 4 Watts



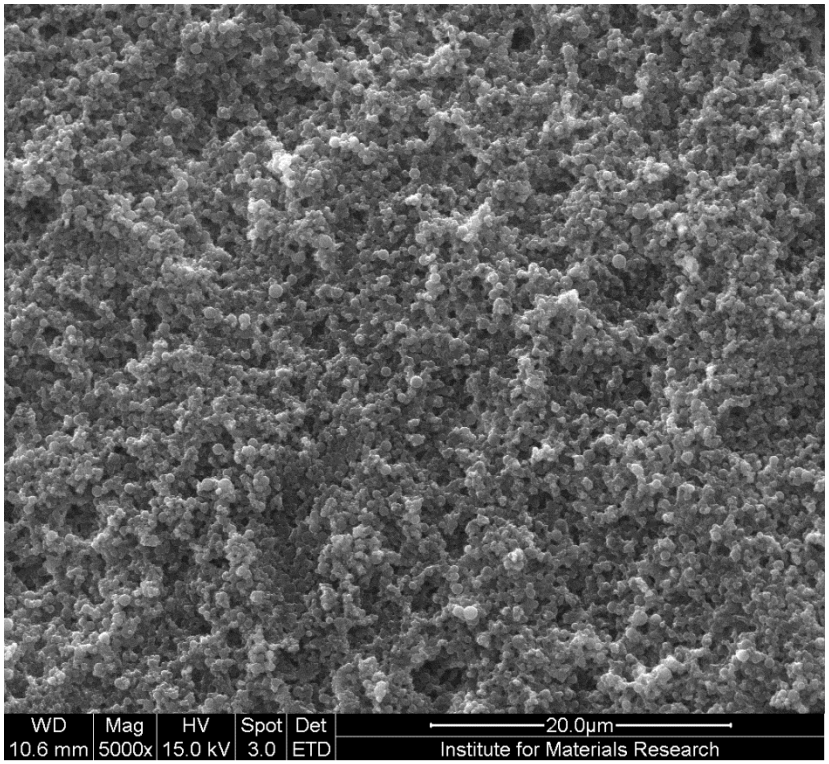


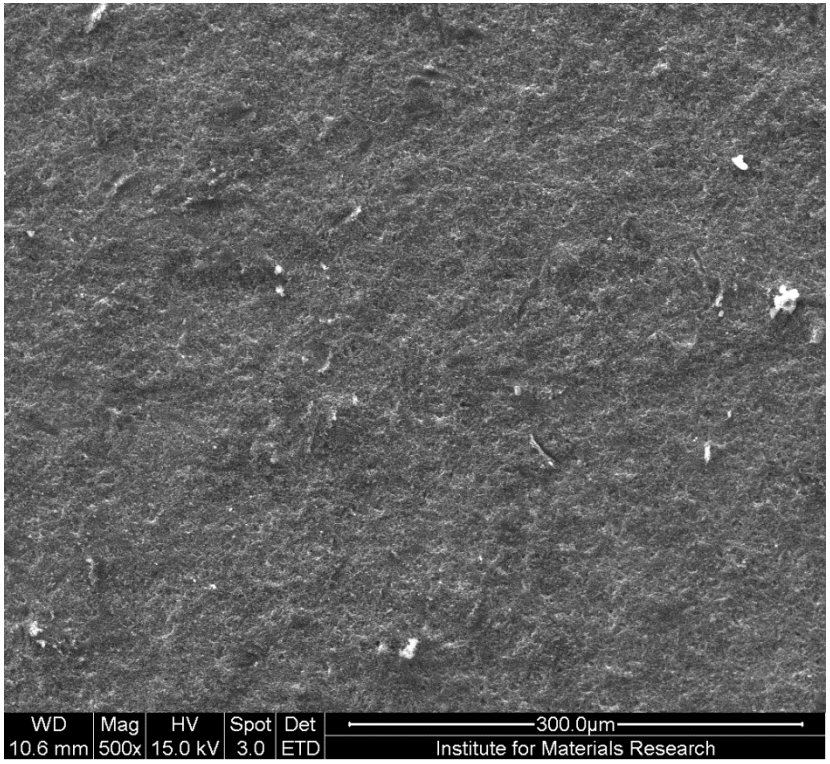
Multi pass – 70% ethanol, not washed, 90°C, 0.2 ml/min, 5 passes, 4 Watts





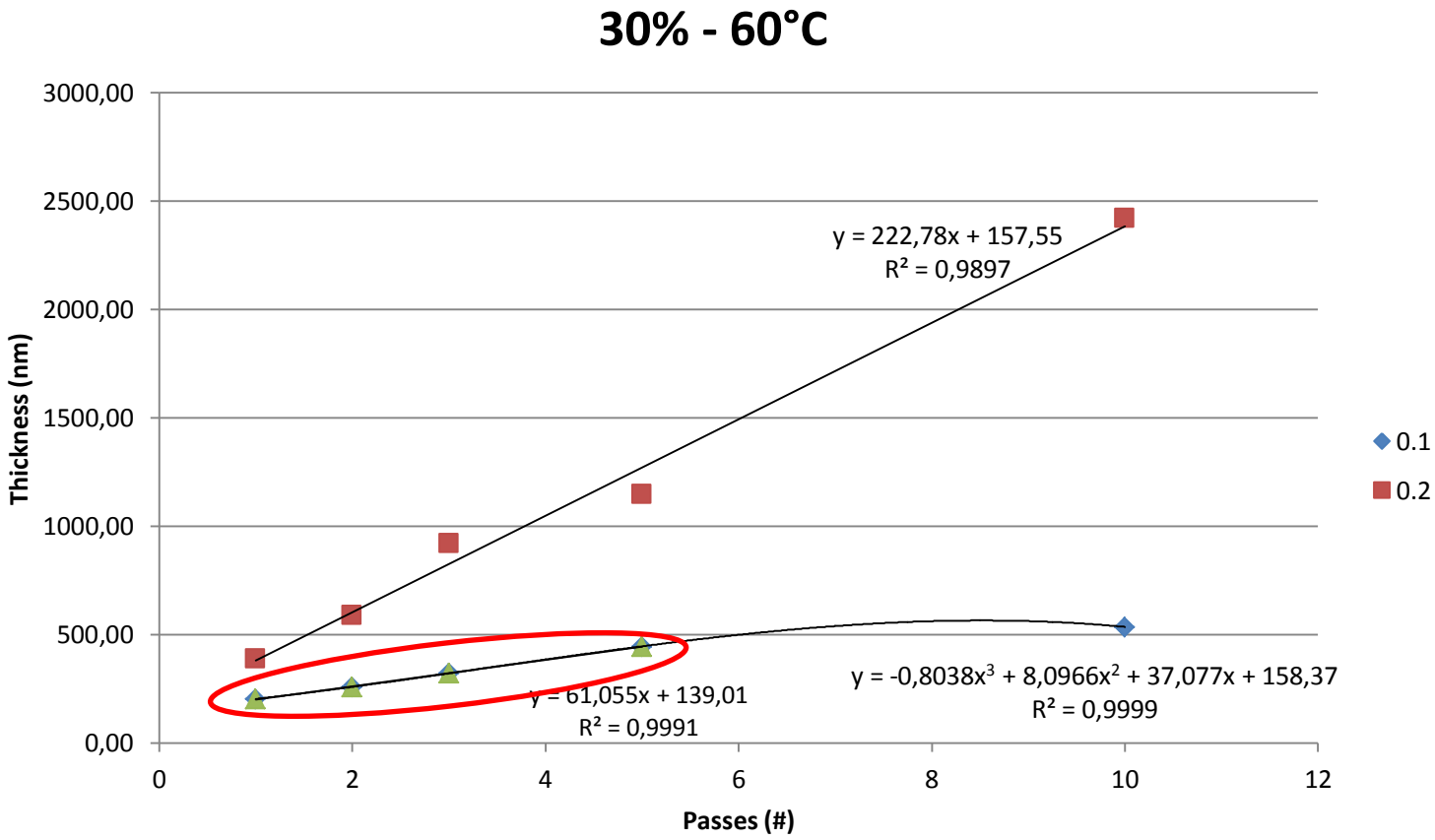
Multi pass – 70% ethanol, not washed, 90°C, 0.2 ml/min, 10 passes, 4 Watts



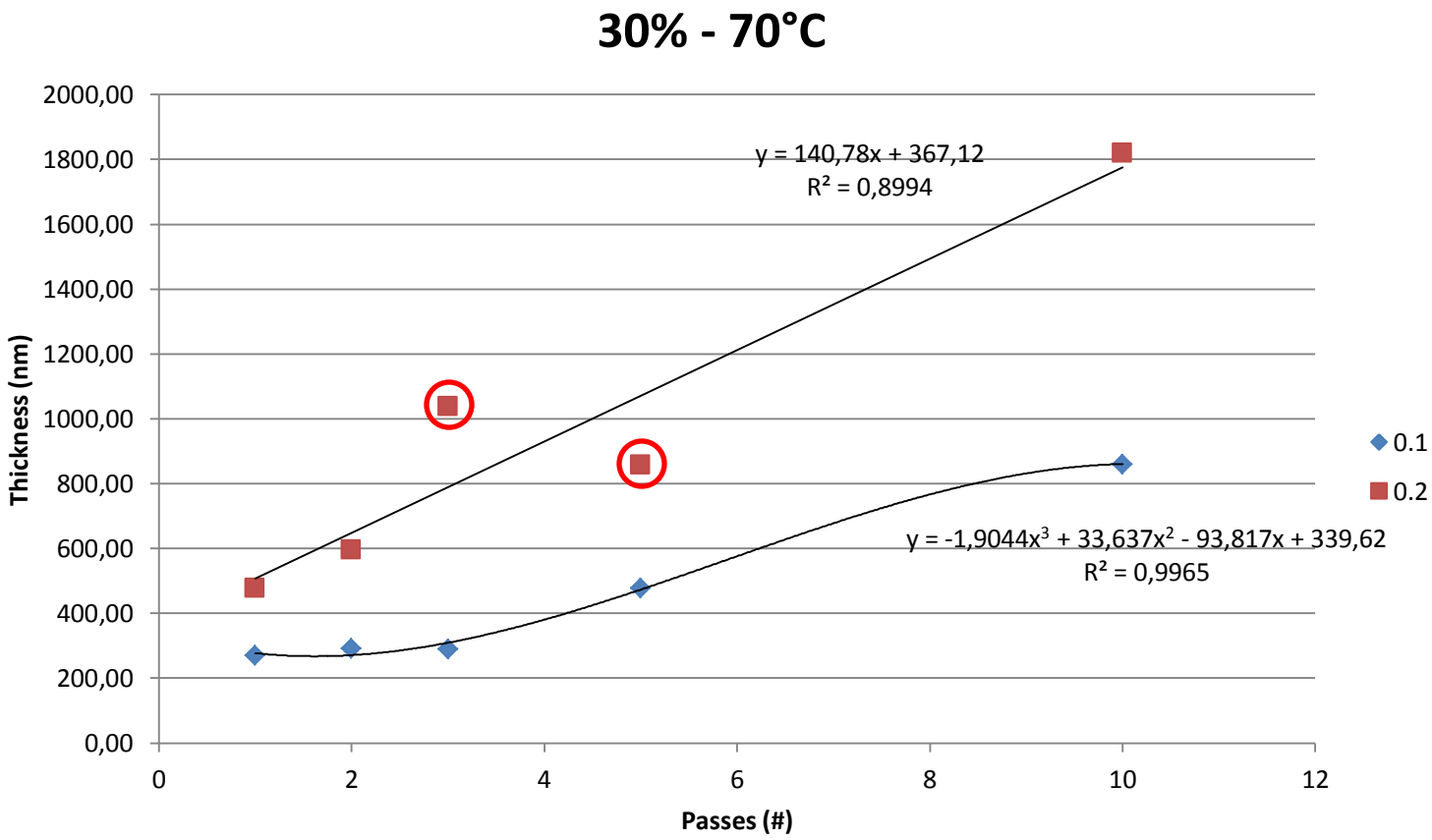


Thickness

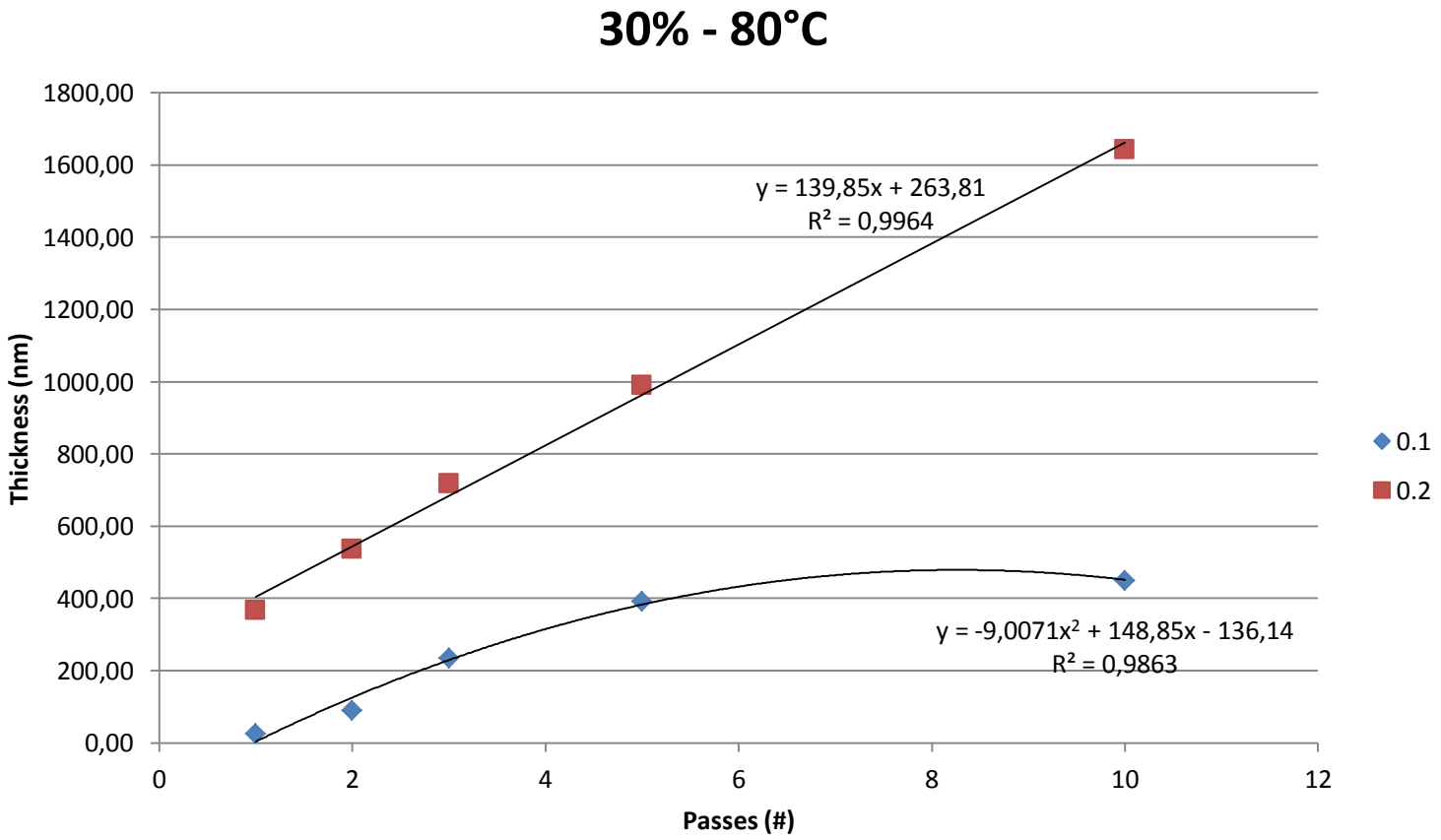
Thickness – 30% ethanol, 60°C



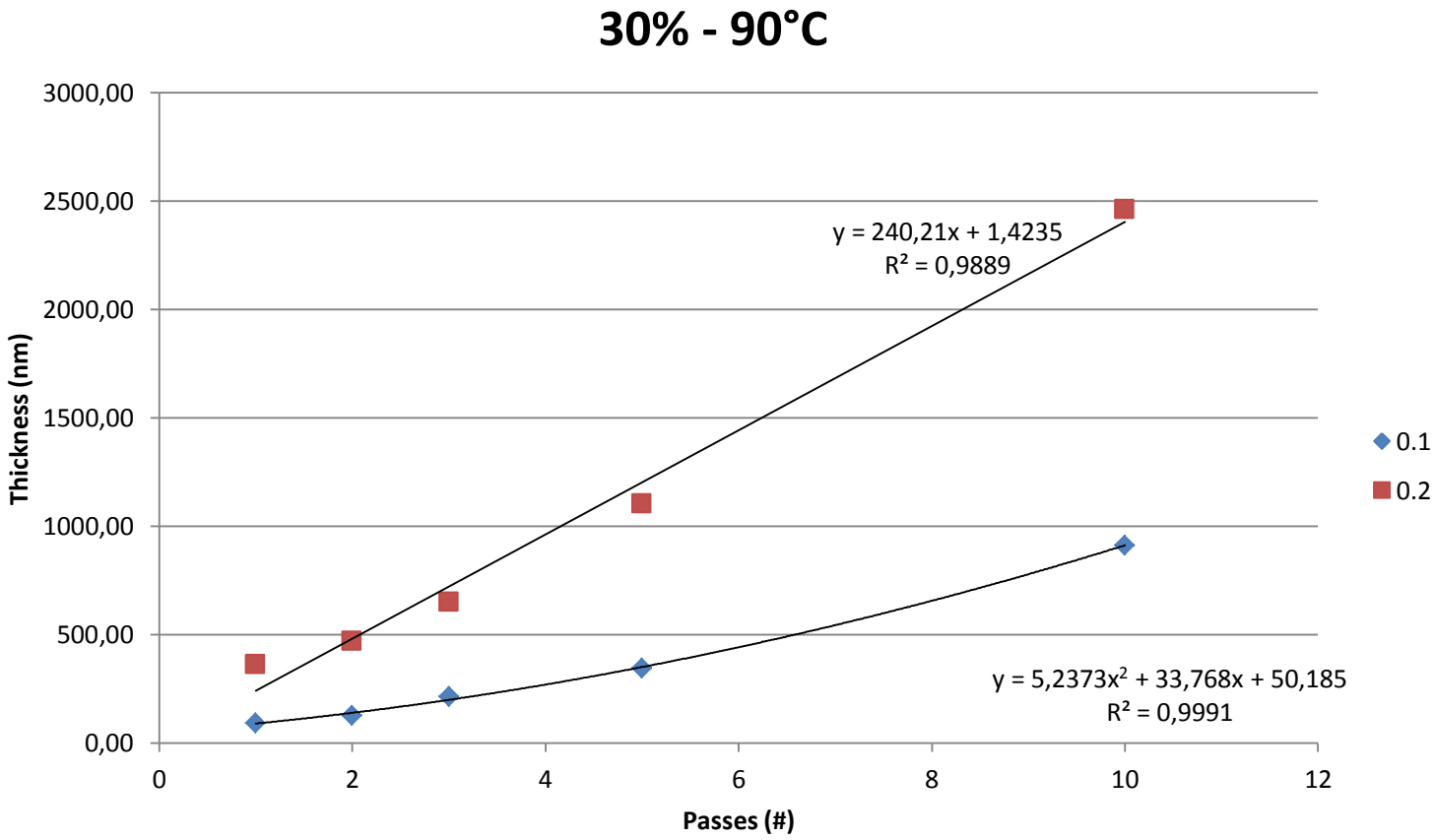
Thickness – 30% ethanol, 70°C



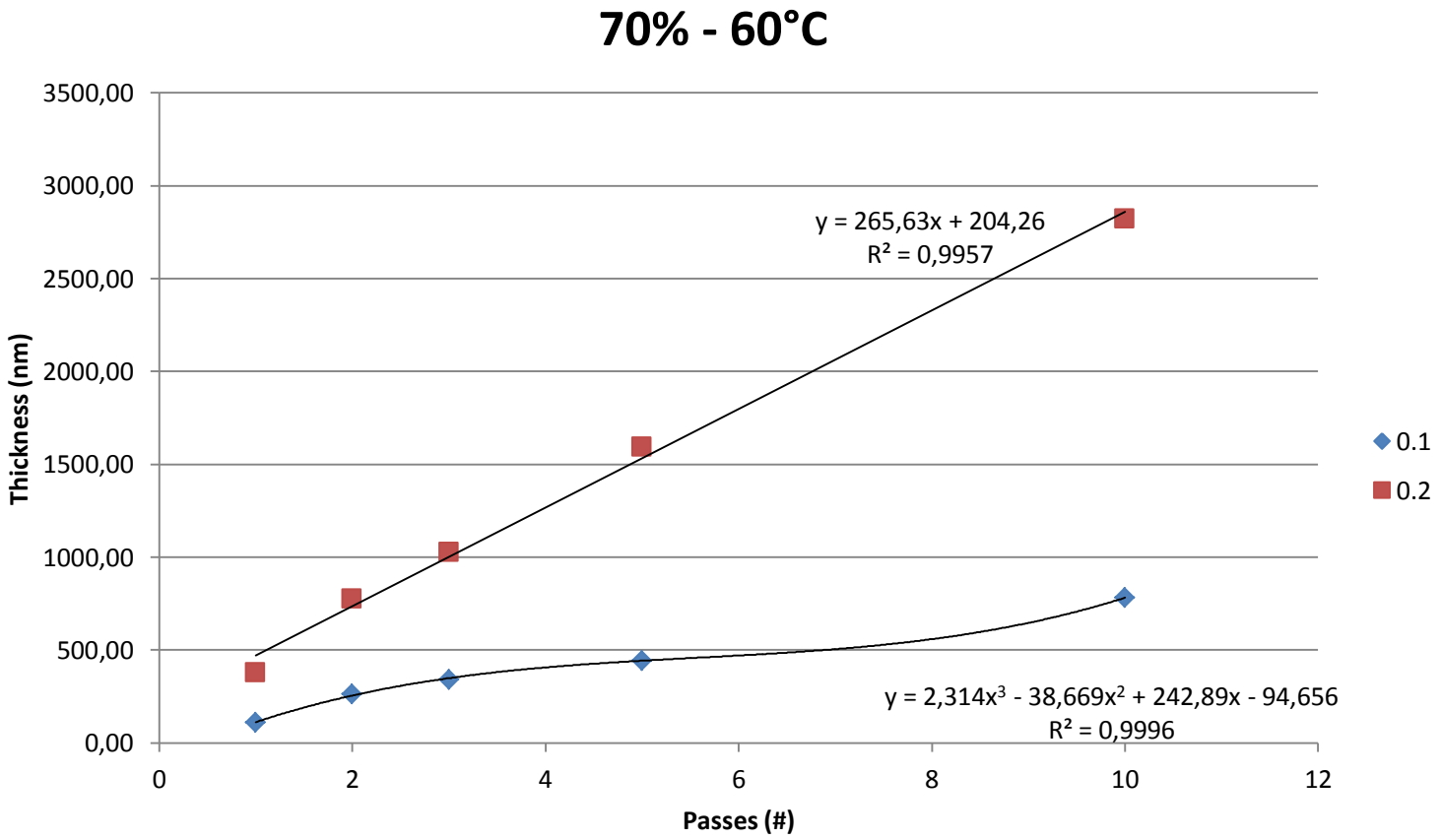
Thickness – 30% ethanol, 80°C



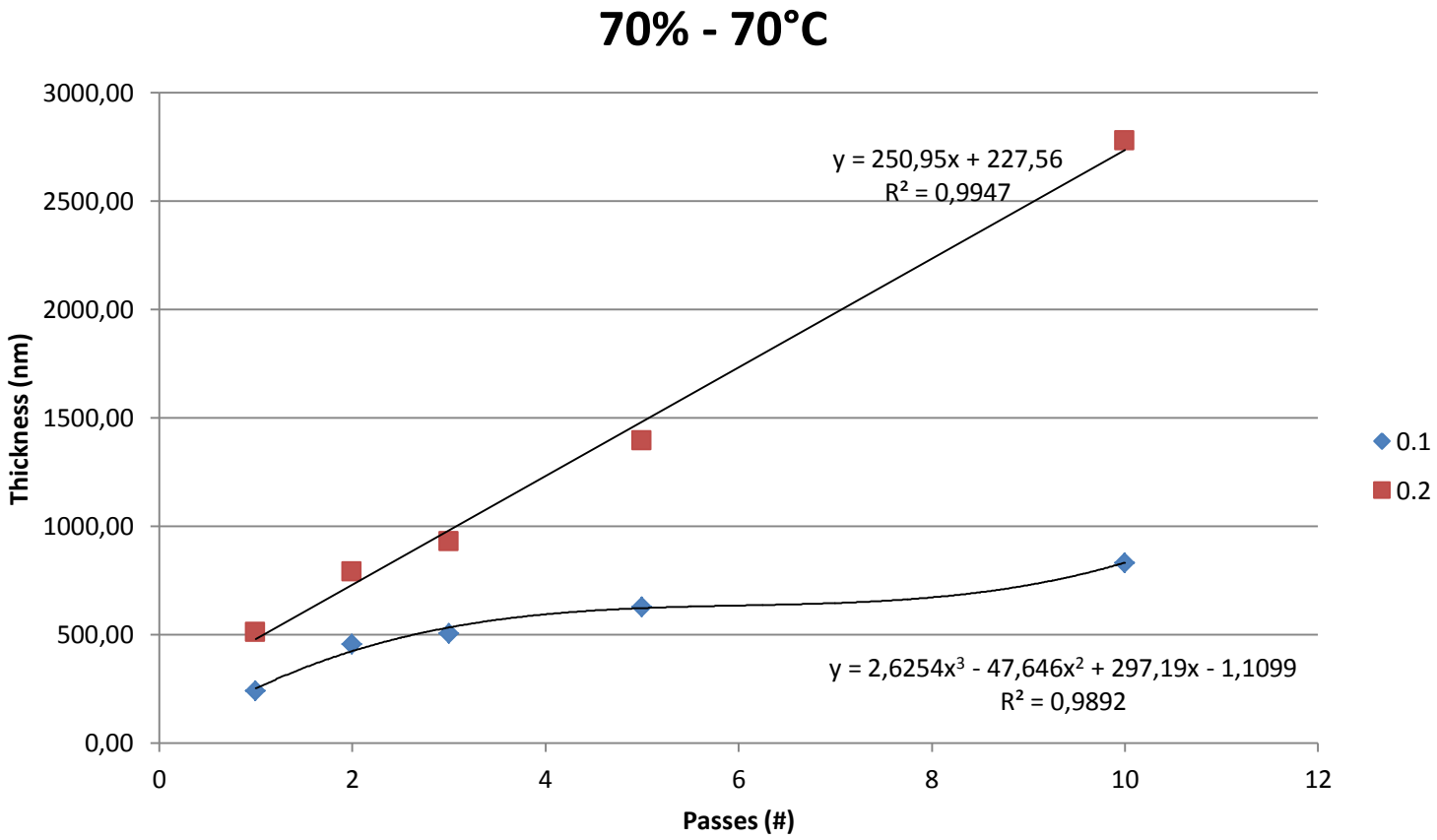
Thickness – 30% ethanol, 90°C



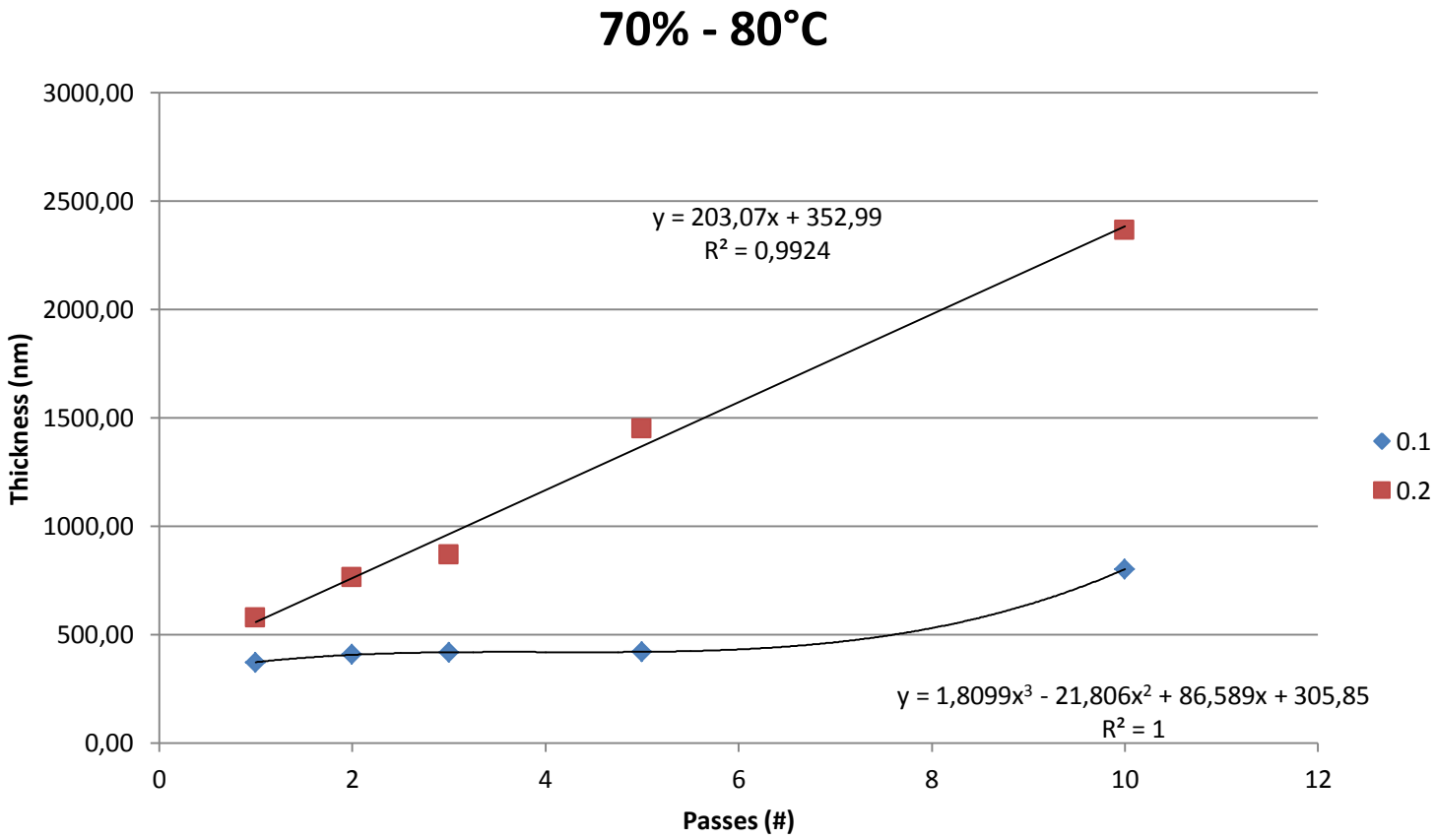
Thickness – 70% ethanol, 60°C



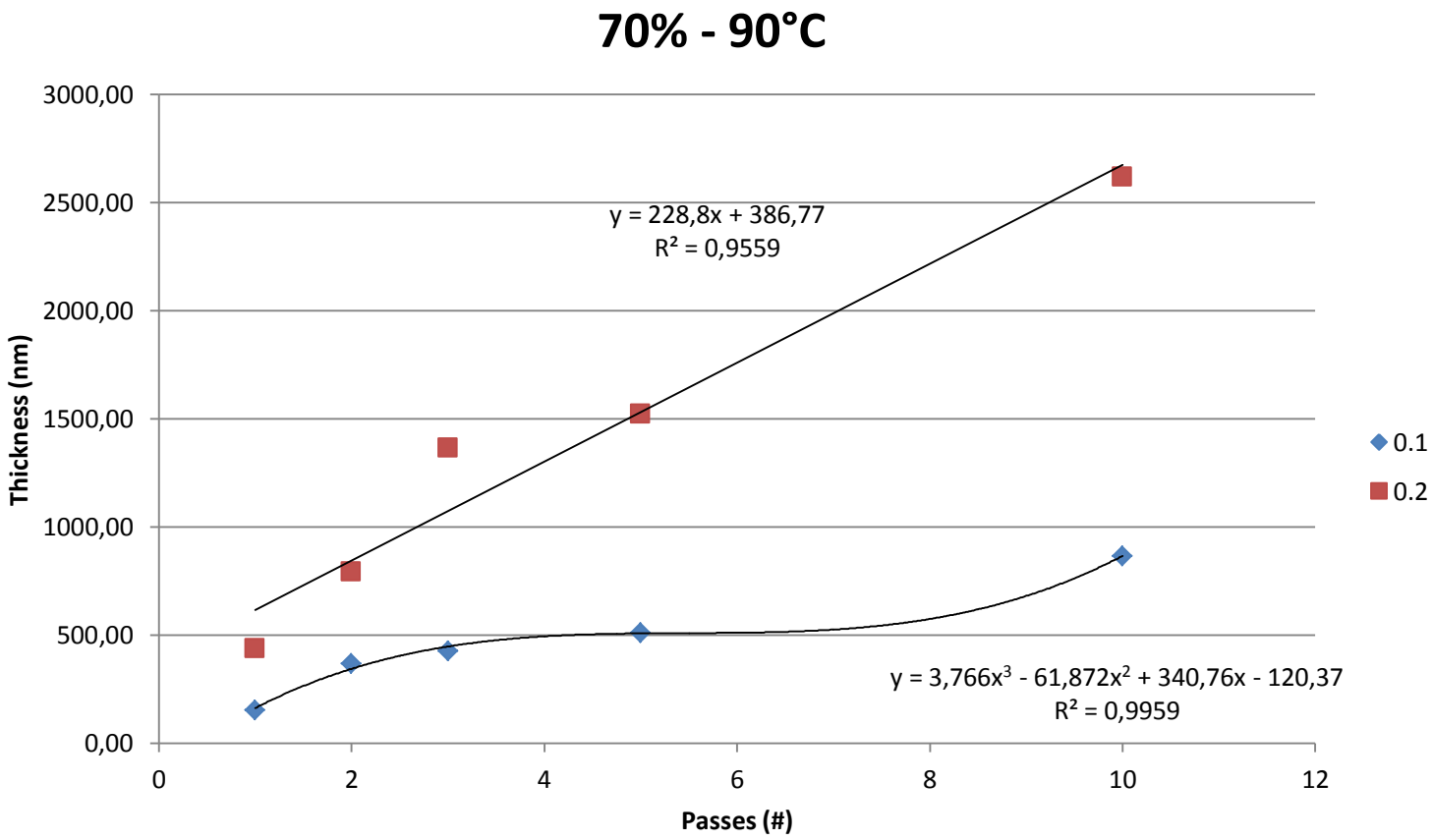
Thickness – 70% ethanol, 70°C



Thickness – 70% ethanol, 80°C



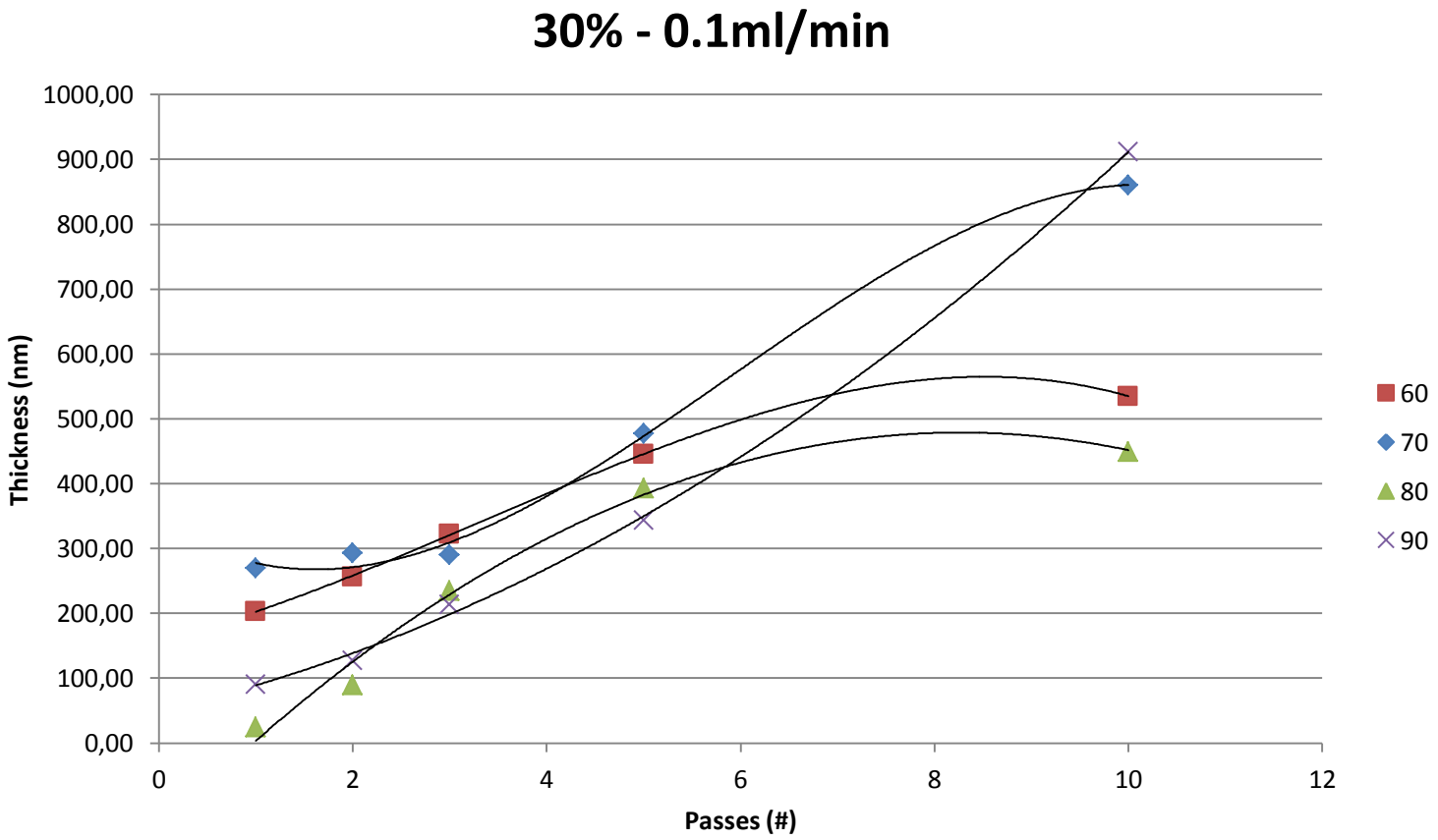
Thickness – 70% ethanol, 90°C



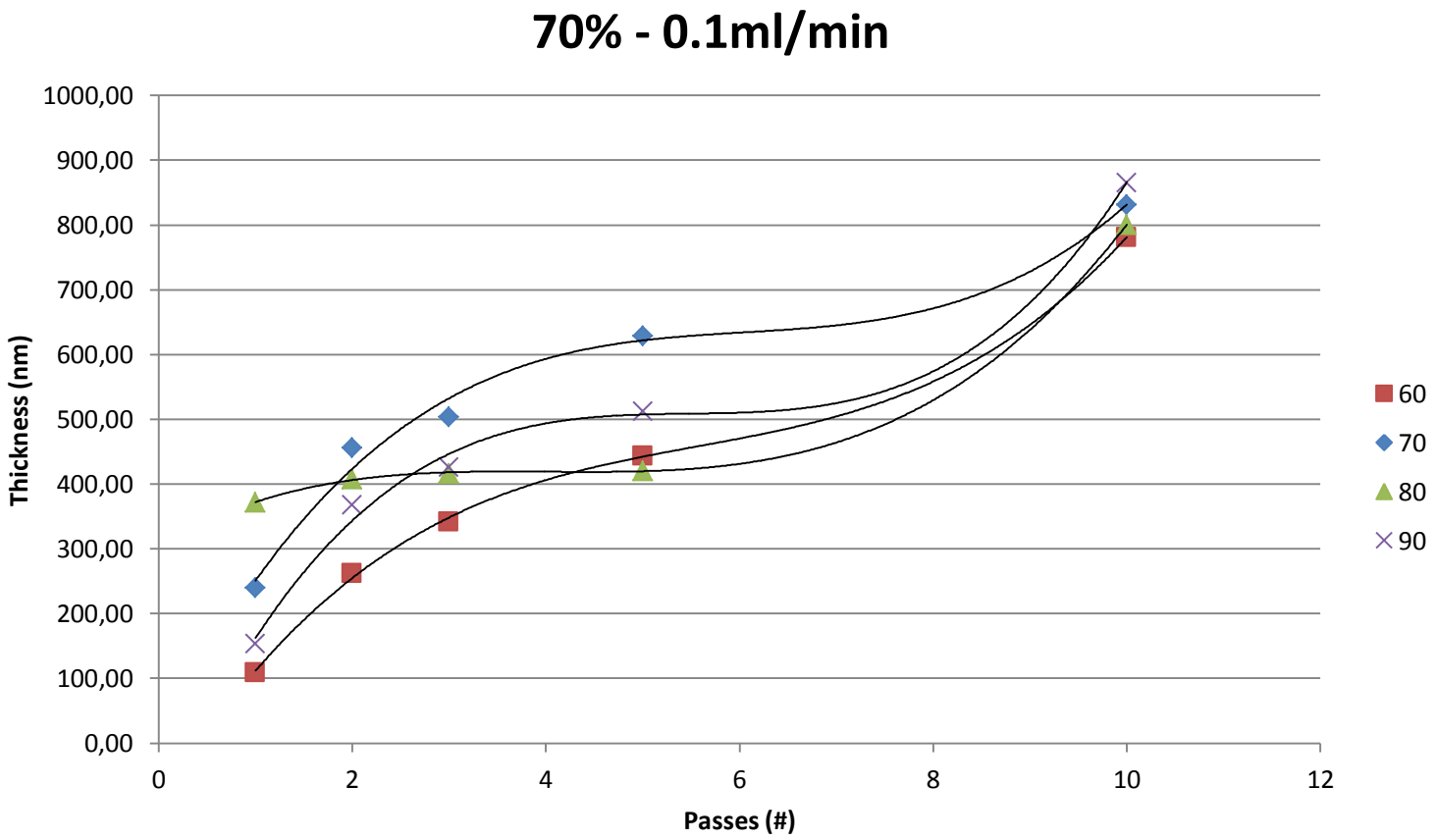
Thickness

- The behavior of the thickness is similar in different temperatures.
- But we an see the difference between the 0.1 and 0.2 ml/ml
- As the 0.1 ml/min let more holes in the layer the growth oh the thickness are more slow, because the next layer fills the holes of the previous

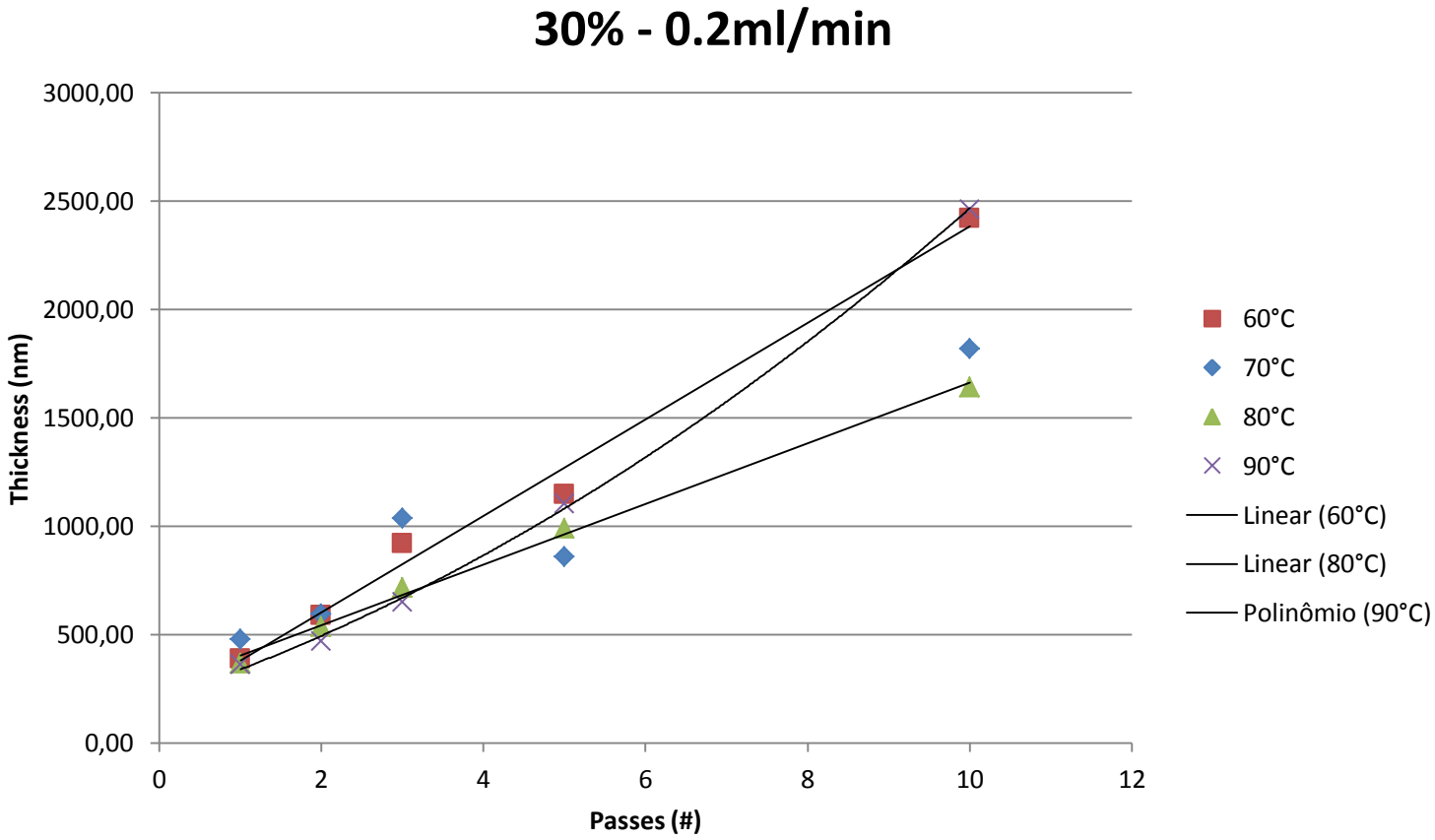
Thickness – 30% ethanol



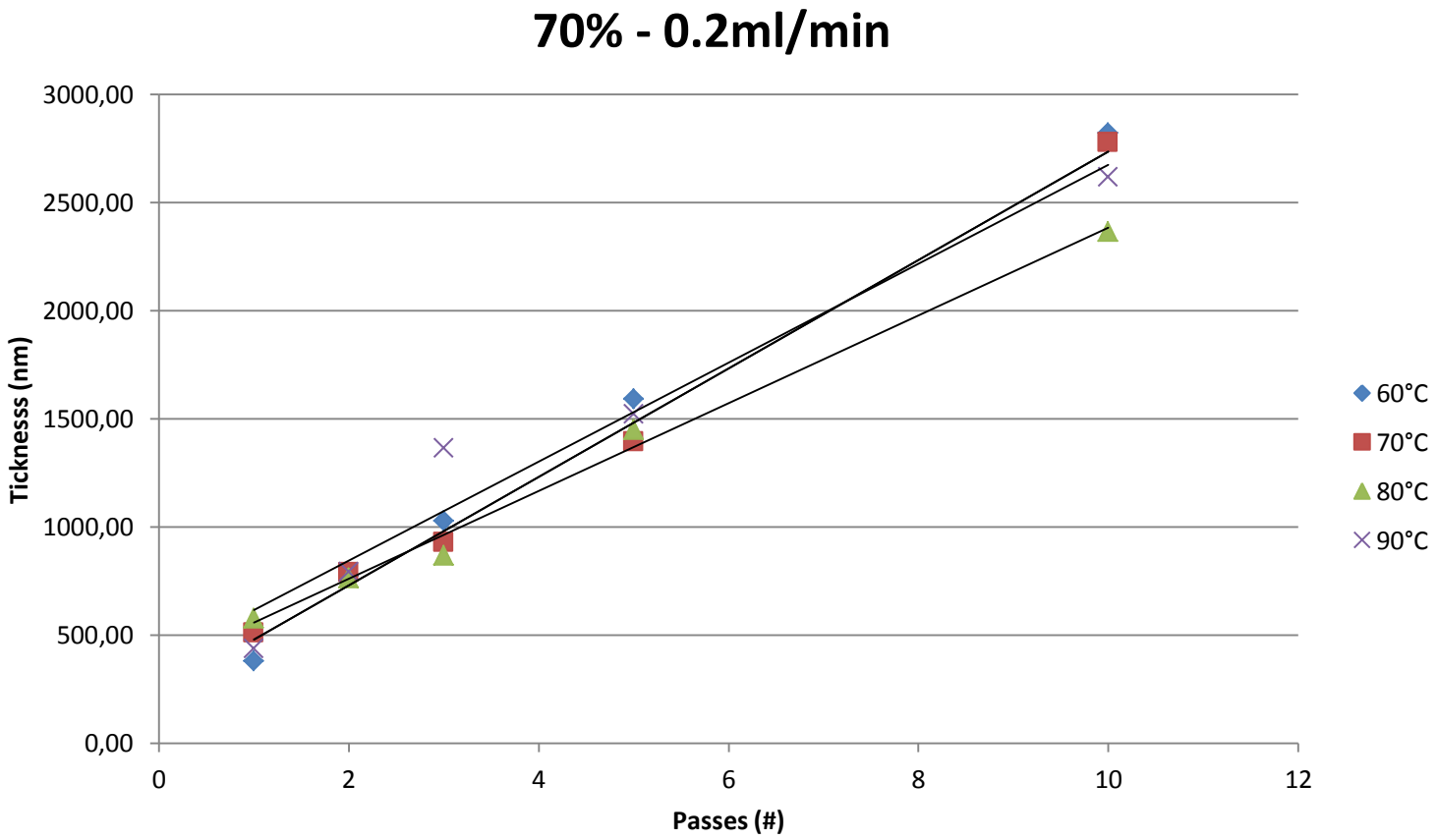
Thickness – 70% ethanol



Thickness – 30% ethanol



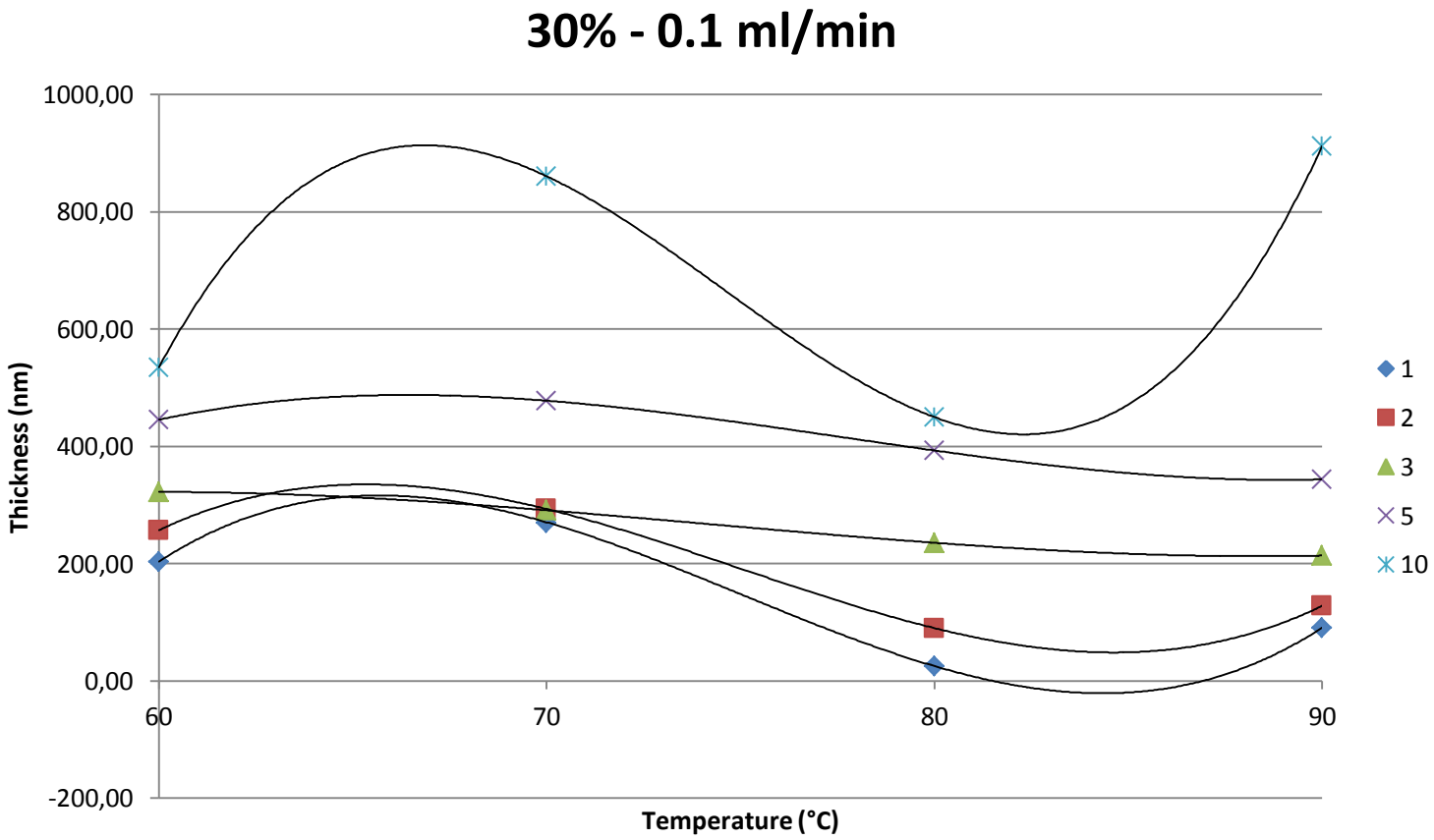
Thickness – 70% ethanol



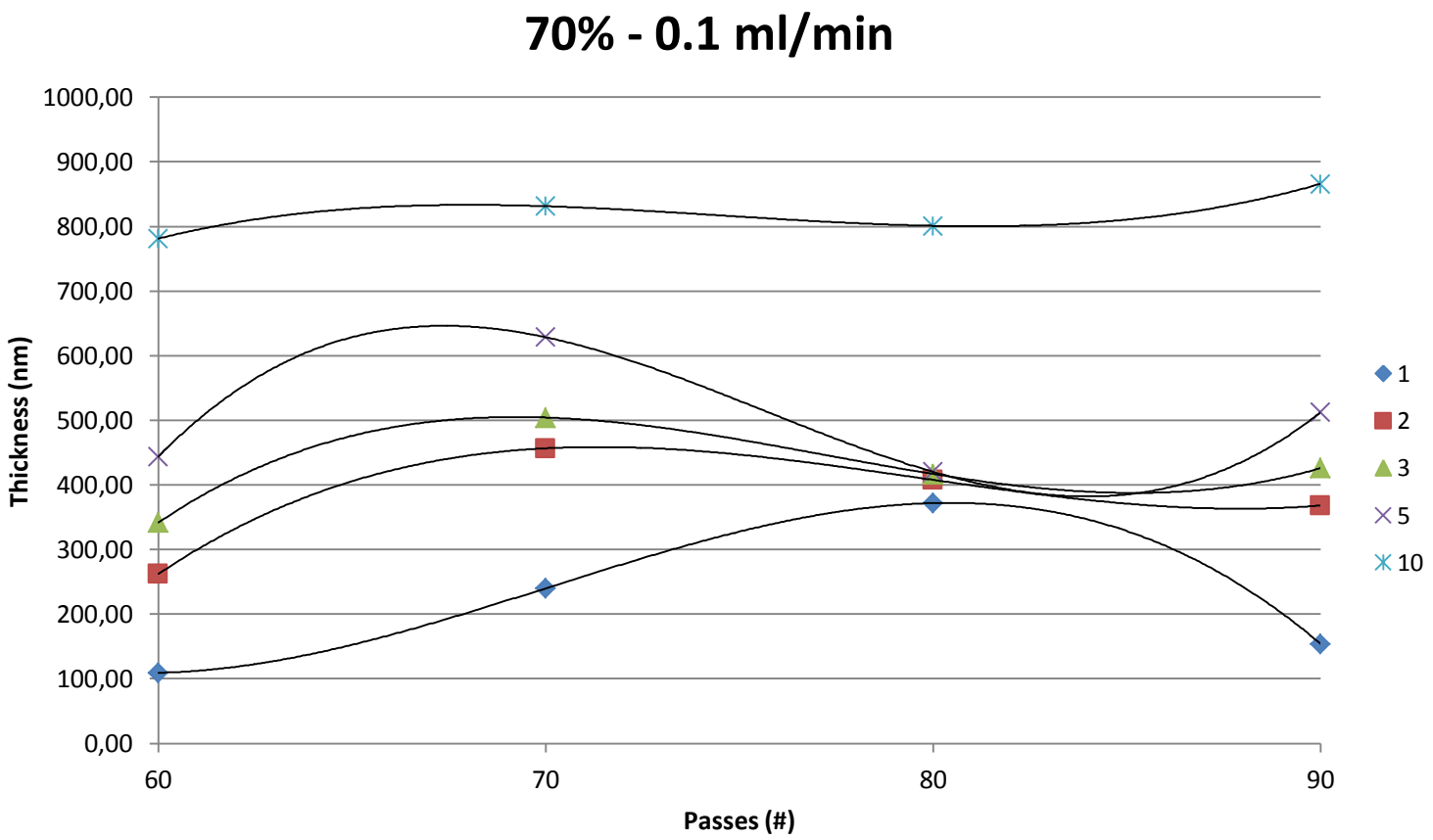
Thickness

- It is possible to see a baseline in inch pass, so the temperature is not determining factor.
- The point that are not on the baseline can be because of the big error bar.

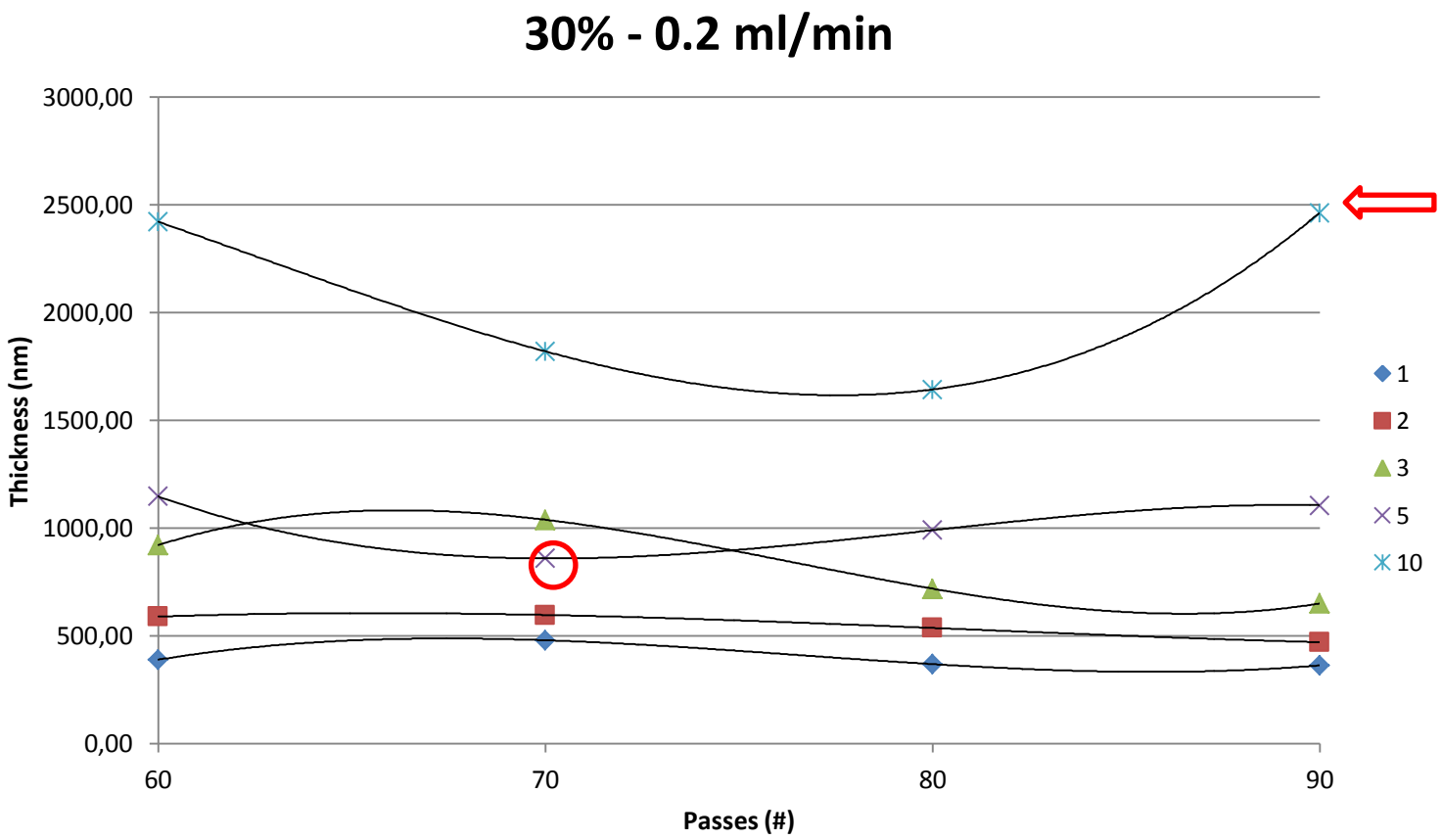
Thickness – 30% ethanol



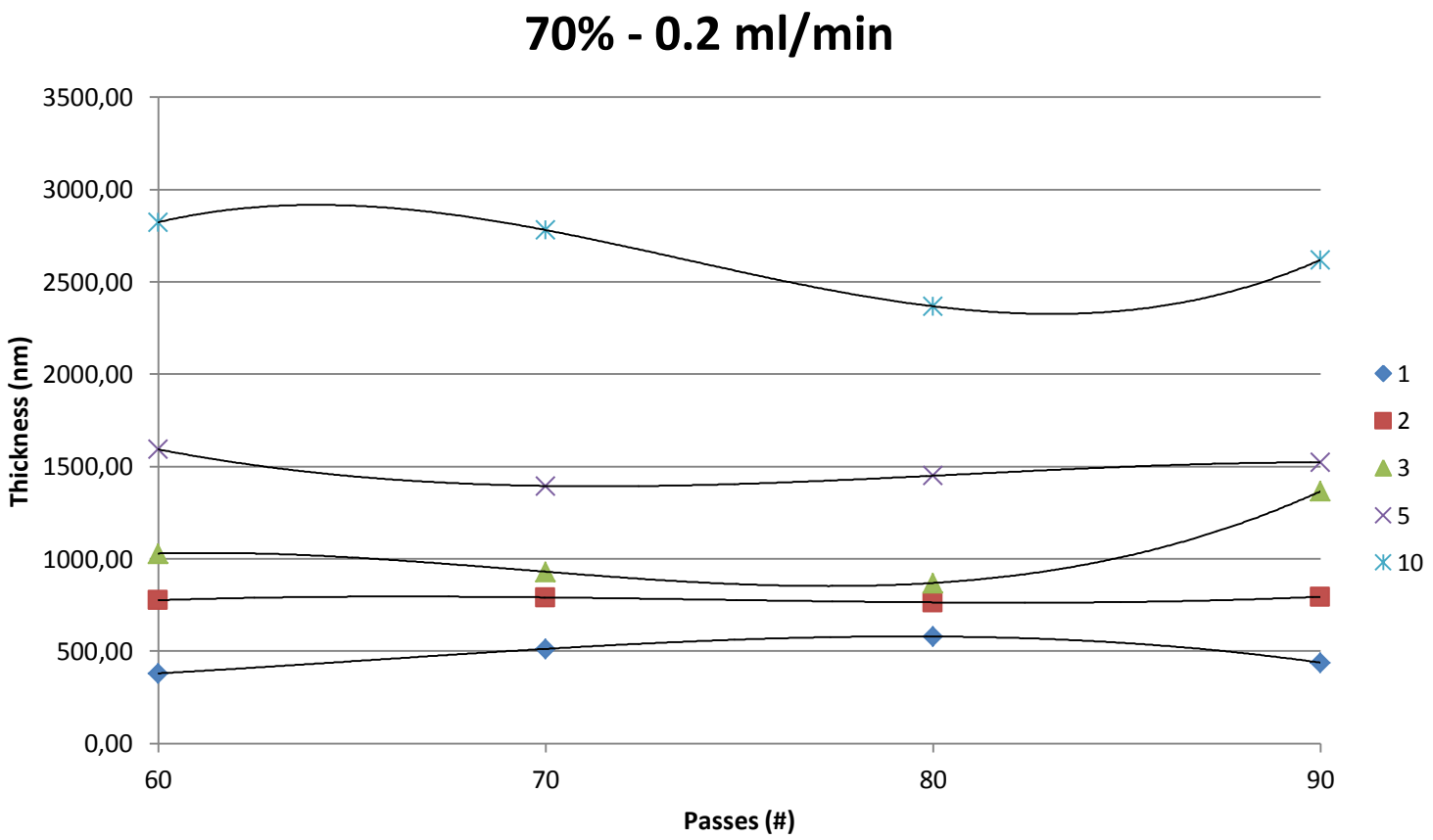
Thickness – 70% ethanol



Thickness – 30% ethanol



Thickness – 70% ethanol



Next Step

- As the temperature is not a determinant factor, we will use just one temperature to the next experiments (70°C)
- First, it will be printed a base layer with 5 passes of 30% ethanol solution (1%SC) at 0.1 ml/min. As this solution has just 30% ethanol, most parte of it can be evaporated before the achieve of the surface. So the NP don't have much mobility.

Next Step

- To fill the holes of the base layer, it will be used a 50% and 70% ethanol solution (1,2,3,4,5 passes more).
- This following layer will be capable to fill the holes because they have more mobility because of the presence of more ethanol in the solution, so it won't be all evaporated.

Plan B

- If this first plan don't work, it is possible to decrease the percentage of solid content to increase the mobility of the NP
- The possibilities are 0,5% of SC and 0,75%.

Thank you!