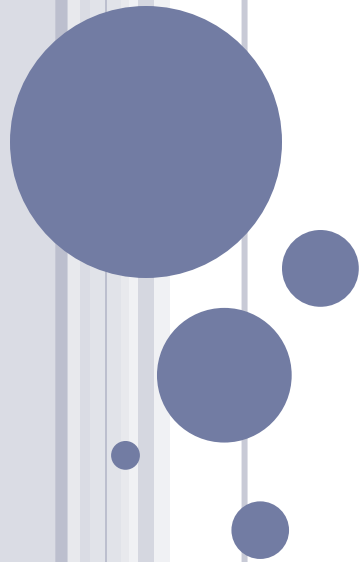


**Anexo 3**

# **SPRAY COATING RESULTS**

**SEM Images and Thickness graphics**



A decorative vertical bar on the left side of the page, consisting of several thin, parallel lines in shades of gray. To the right of the bar are several overlapping circles of varying sizes, all in a dark blue color. The largest circle is at the top left, with smaller ones below and to its right.

# SEM IMAGES

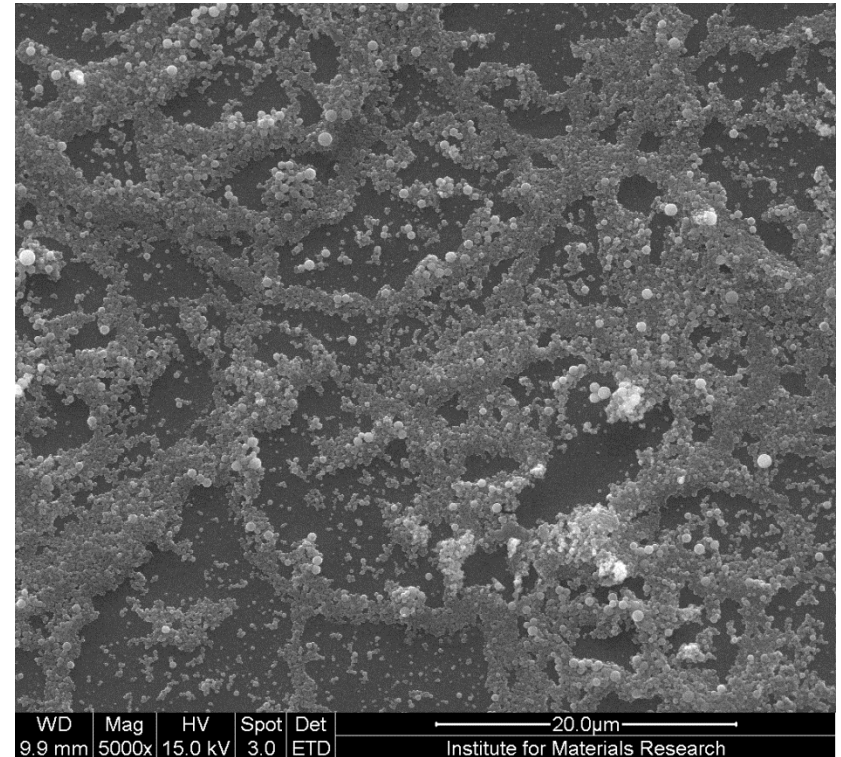
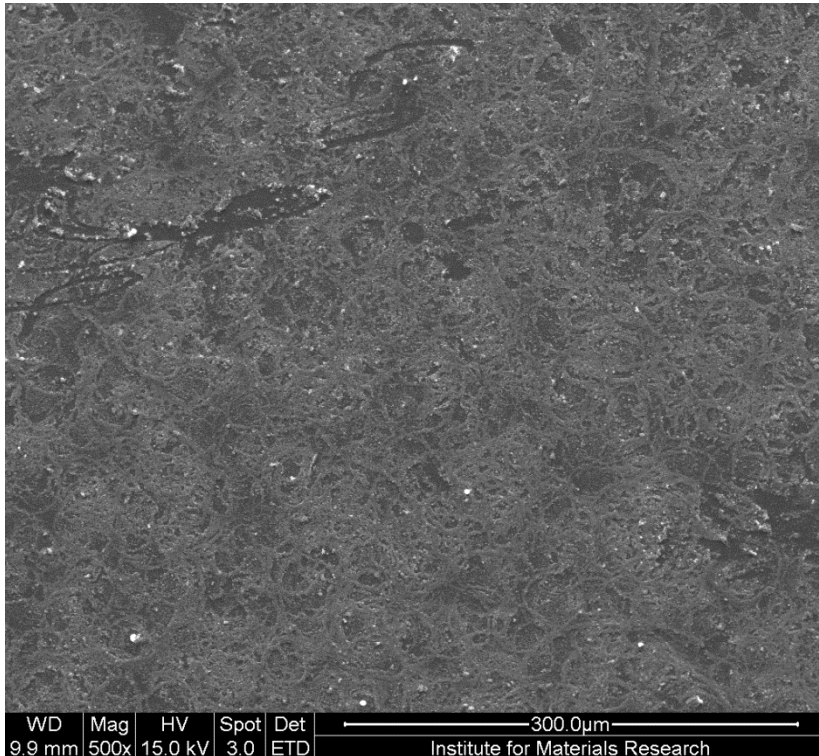
First Printing

## 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.

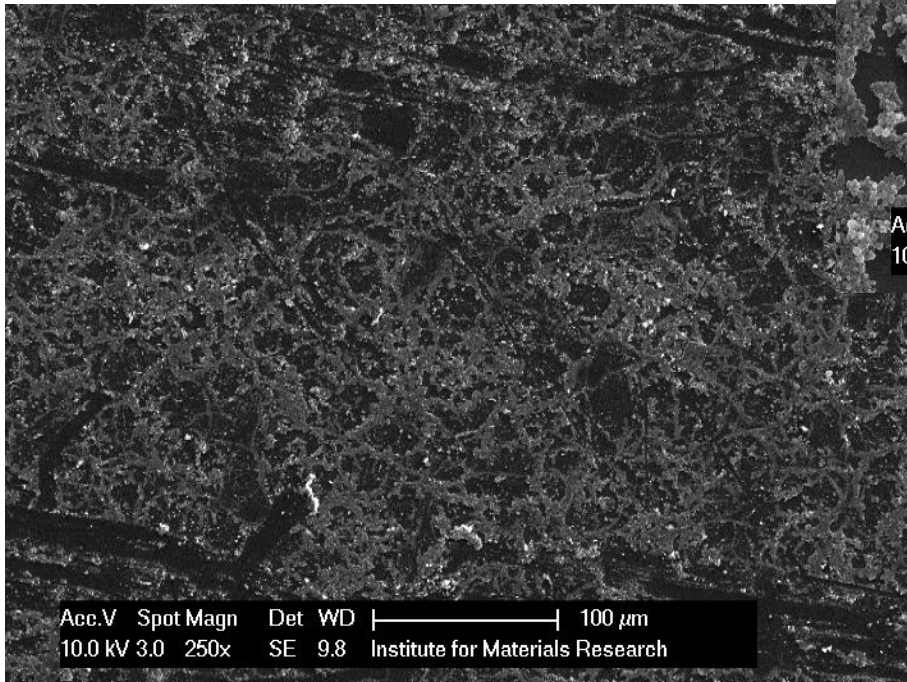
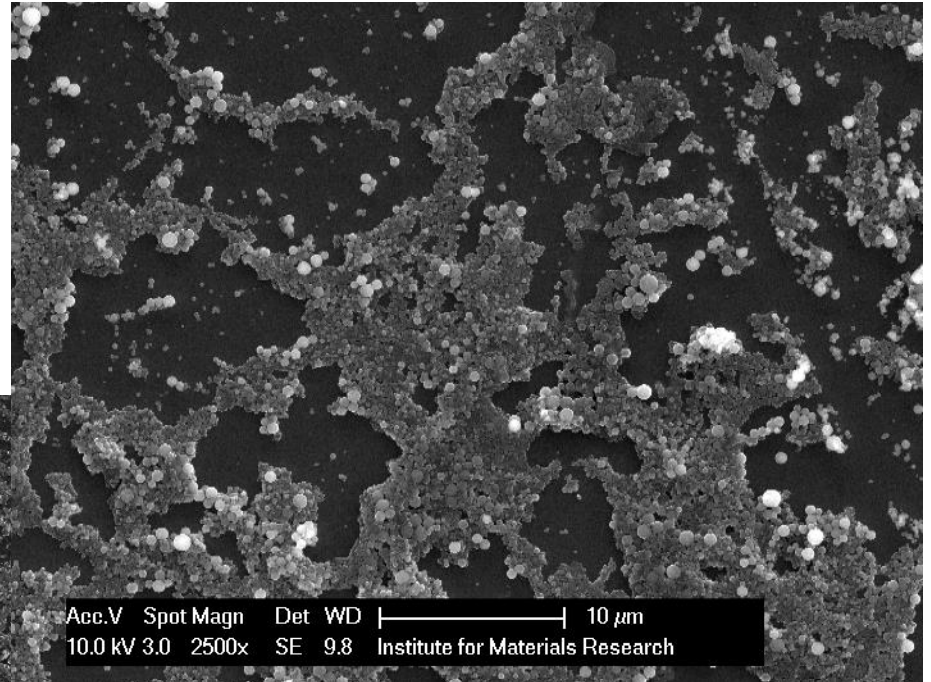


FIRST PRINTING – 30% ETHANOL, WASHED,  
80°C, 0.2 ML/MIN, 1 PASS, 2,5 WATTS

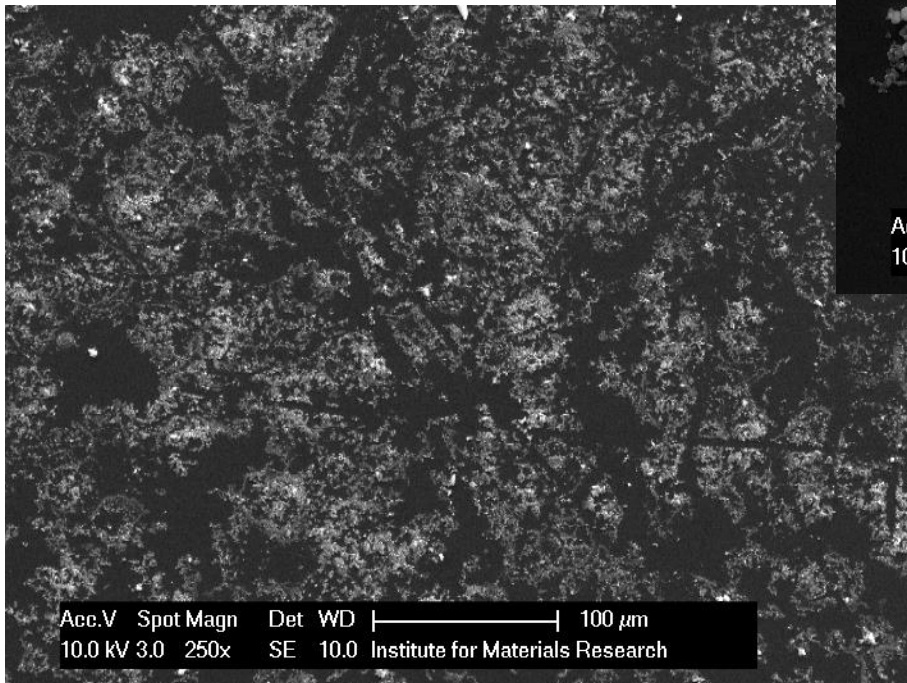
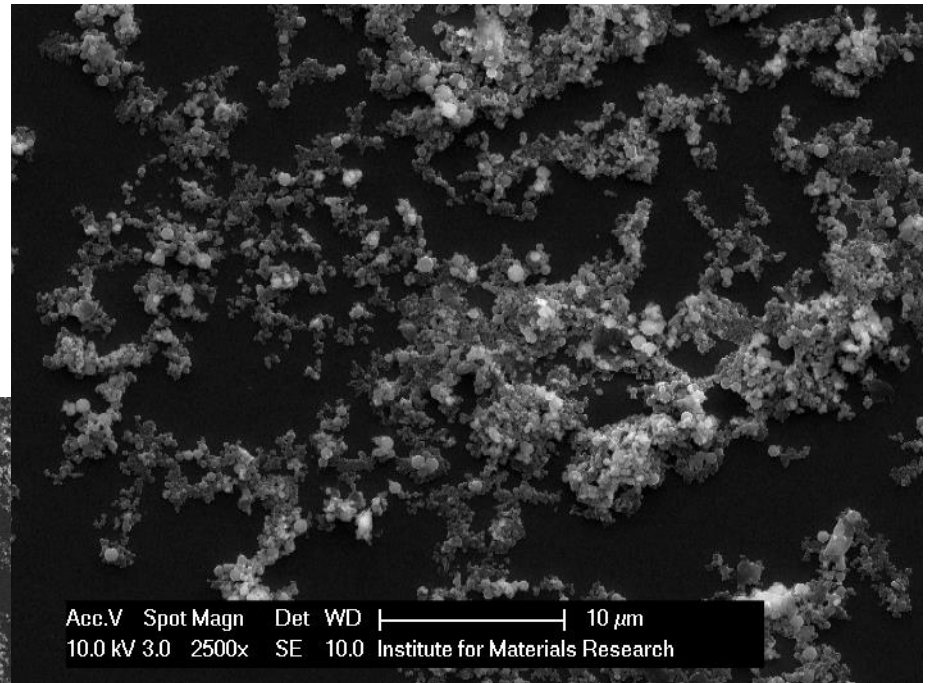




# FIRST PRINTING – 30% ETHANOL, NOT WASHED, 70°C, 0.2 ML/MIN, 1 PASS, 2,5 WATTS

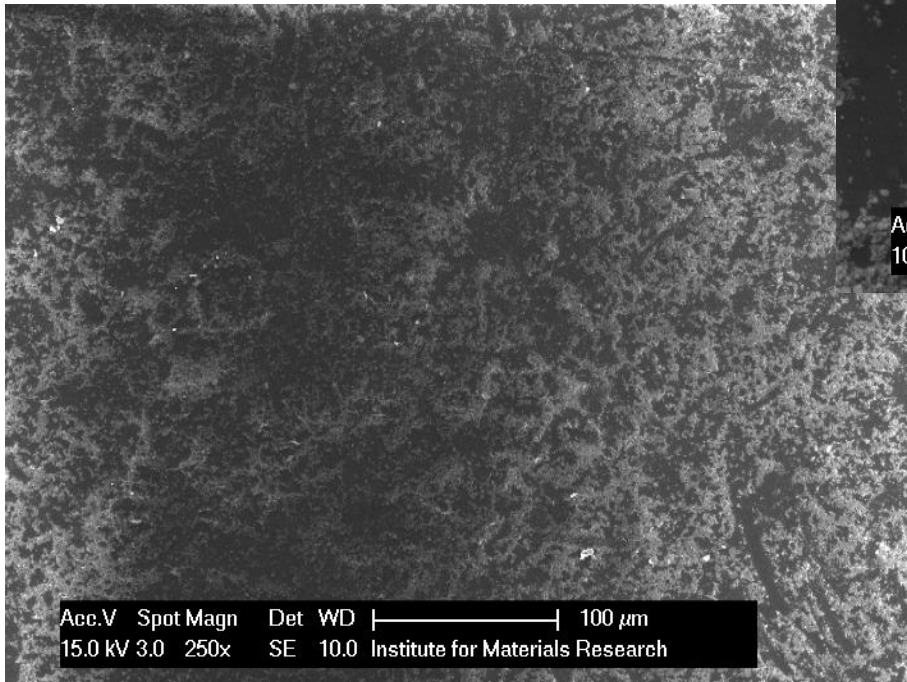
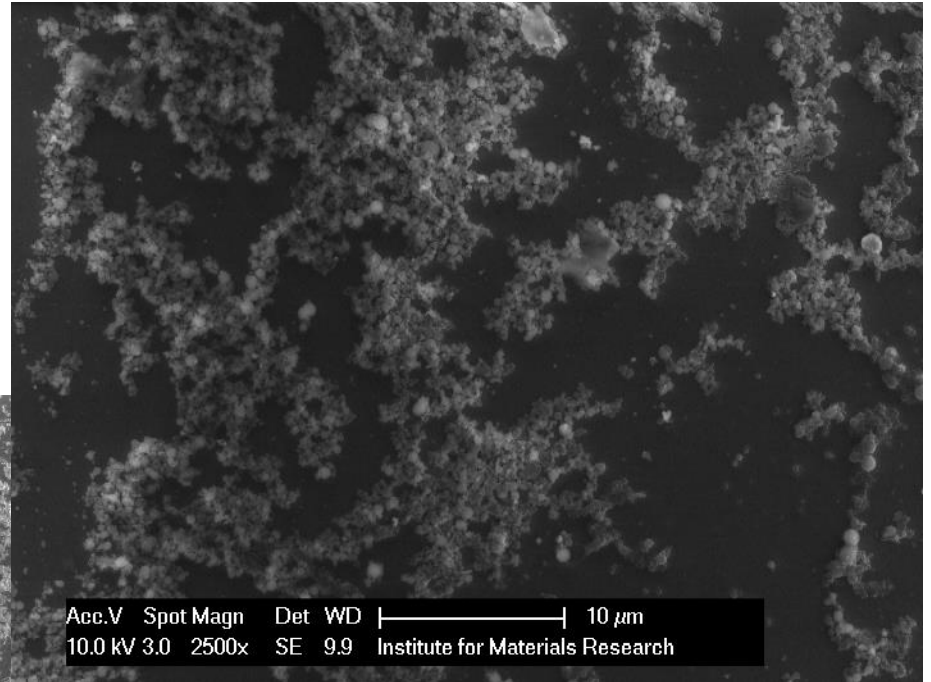


# FIRST PRINTING – 30% ETHANOL, NOT WASHED, 90°C, 0.2 ML/MIN, 1 PASS, 4 WATTS





# 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

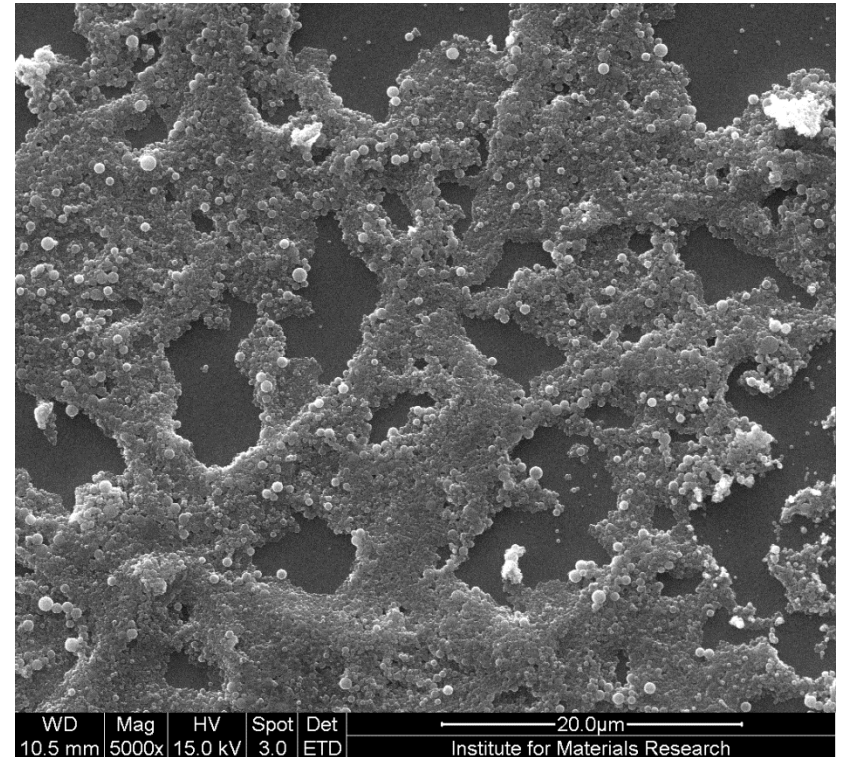
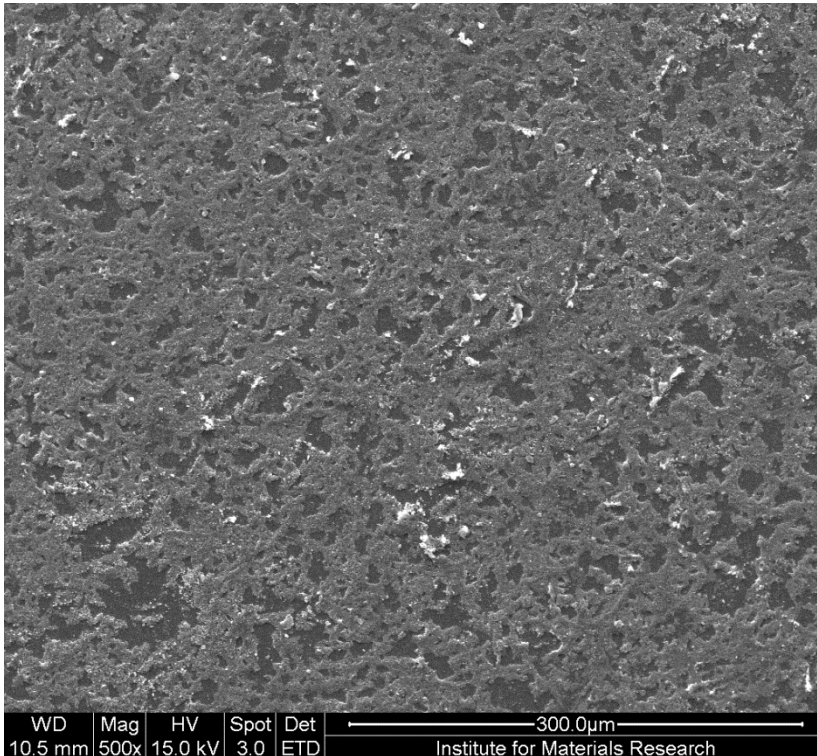


# MULTI PASS PRINTING

- 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.

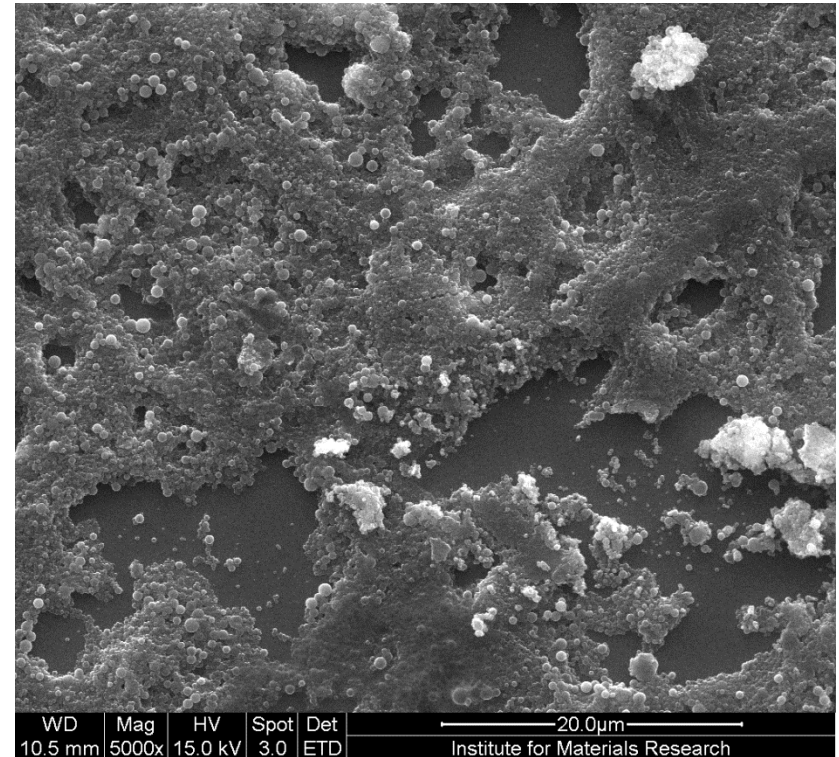
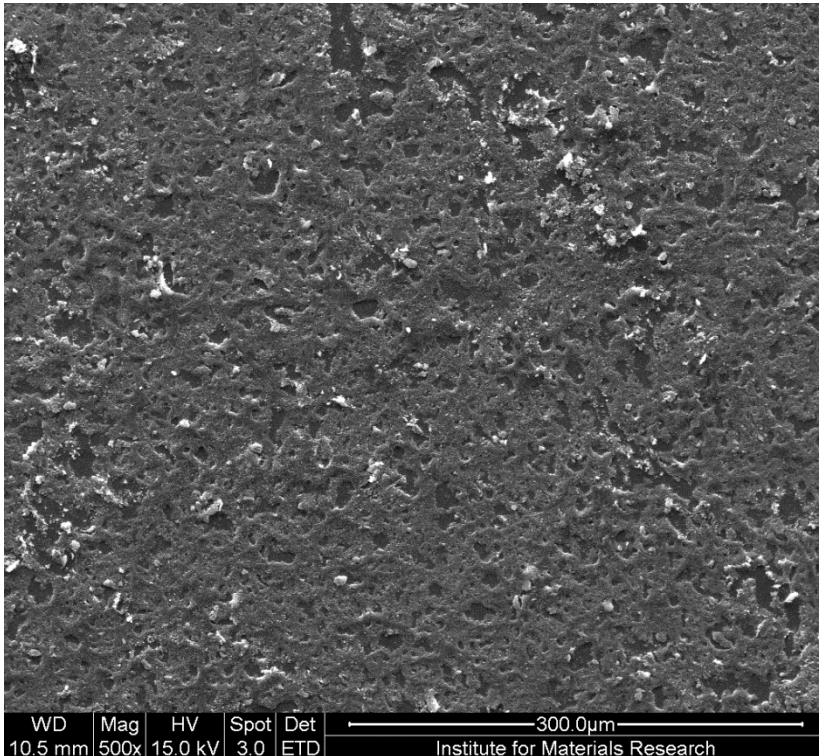


MULTI PASS – 30% ETHANOL, NOT WASHED,  
60°C, 0.2 ML/MIN, 3 PASSES, 4 WATTS

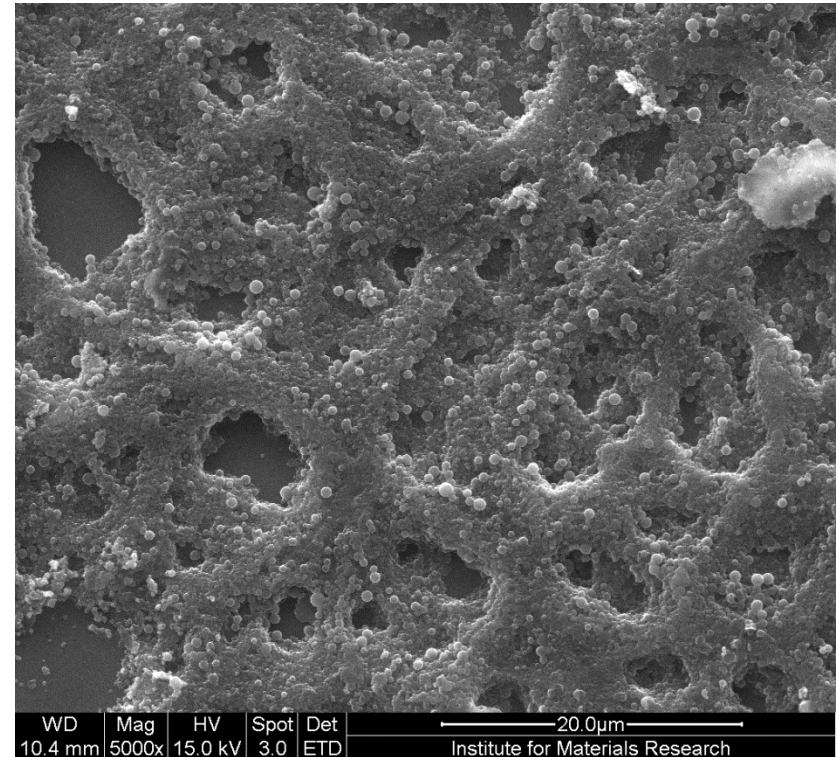
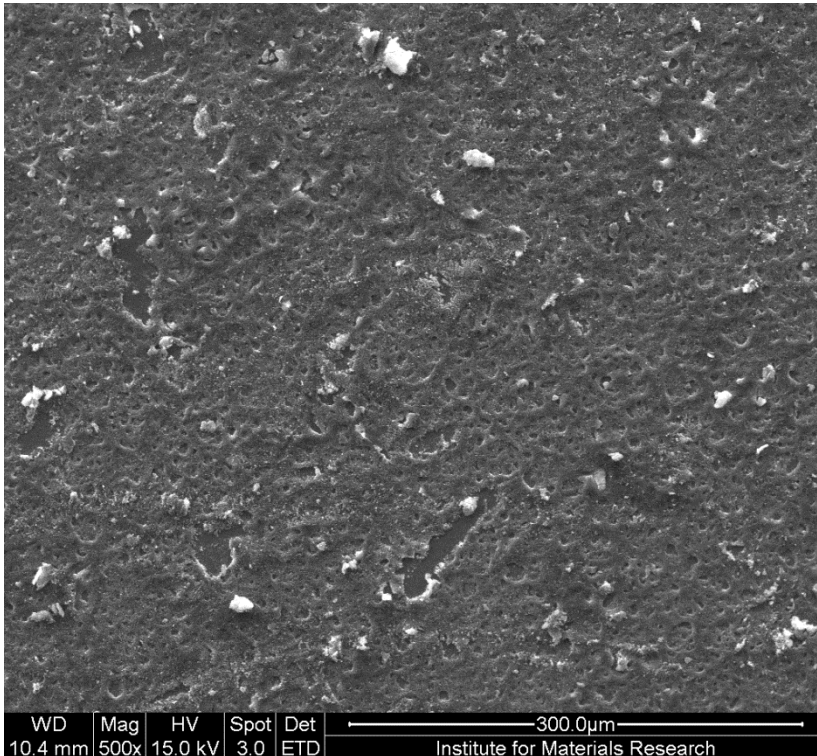




MULTI PASS – 30% ETHANOL, NOT WASHED,  
60°C, 0.2 ML/MIN, 5 PASSES, 4 WATTS

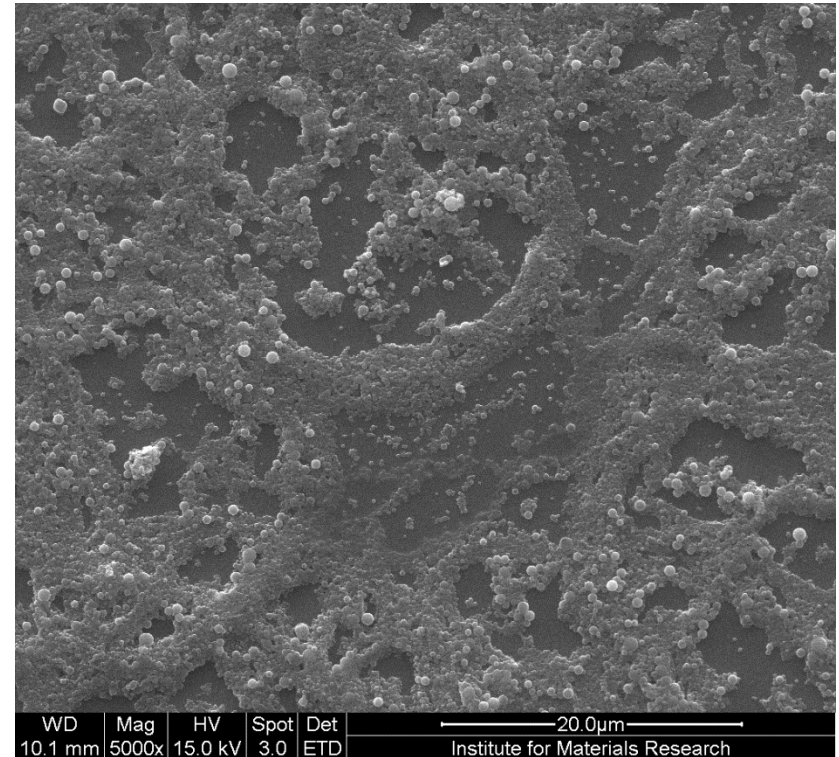
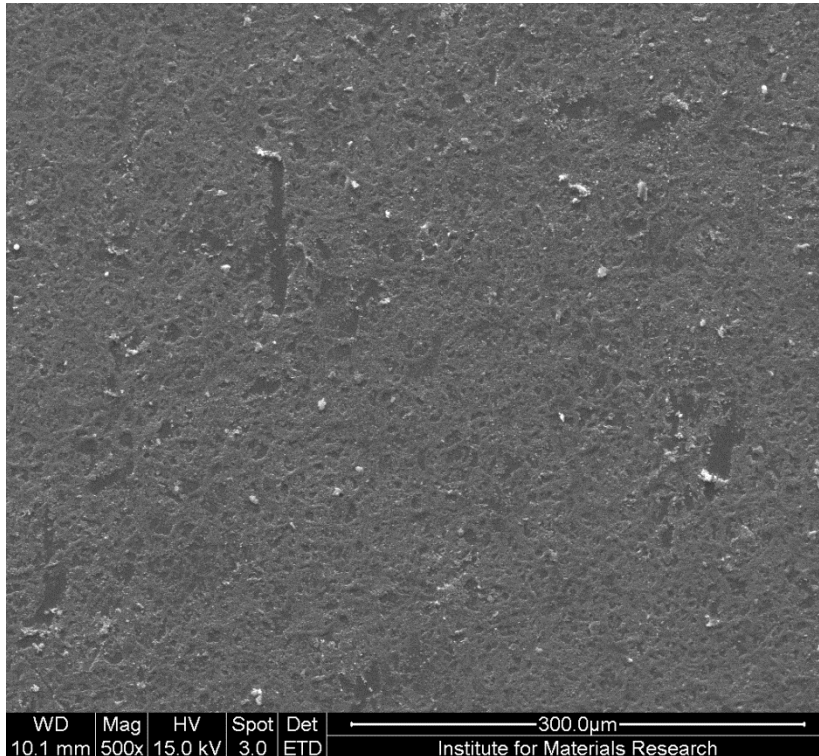


MULTI PASS – 30% ETHANOL, NOT WASHED,  
60°C, 0.2 ML/MIN, 10 PASSES, 4 WATTS

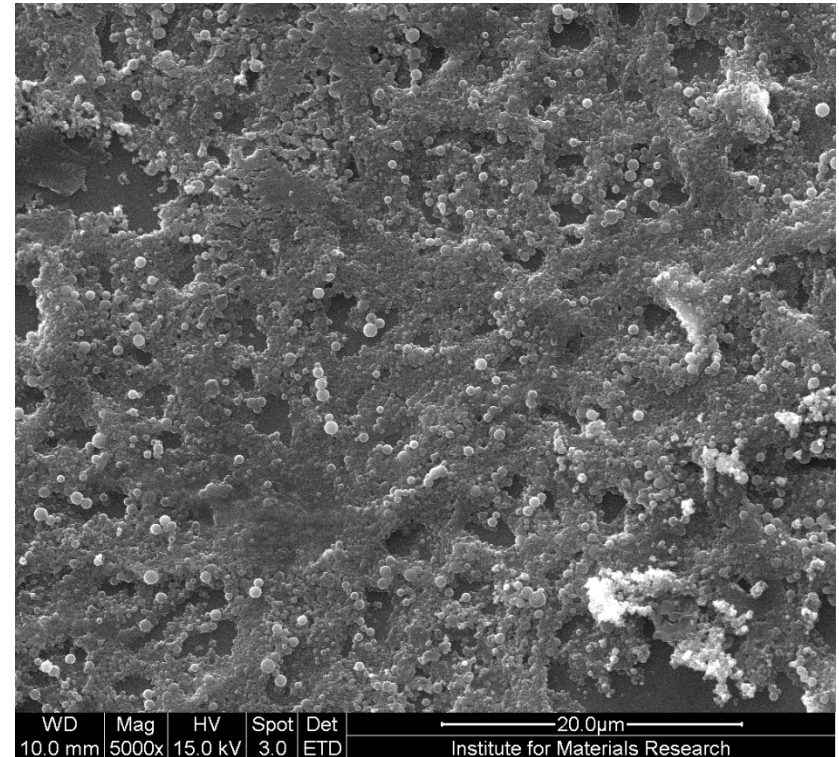
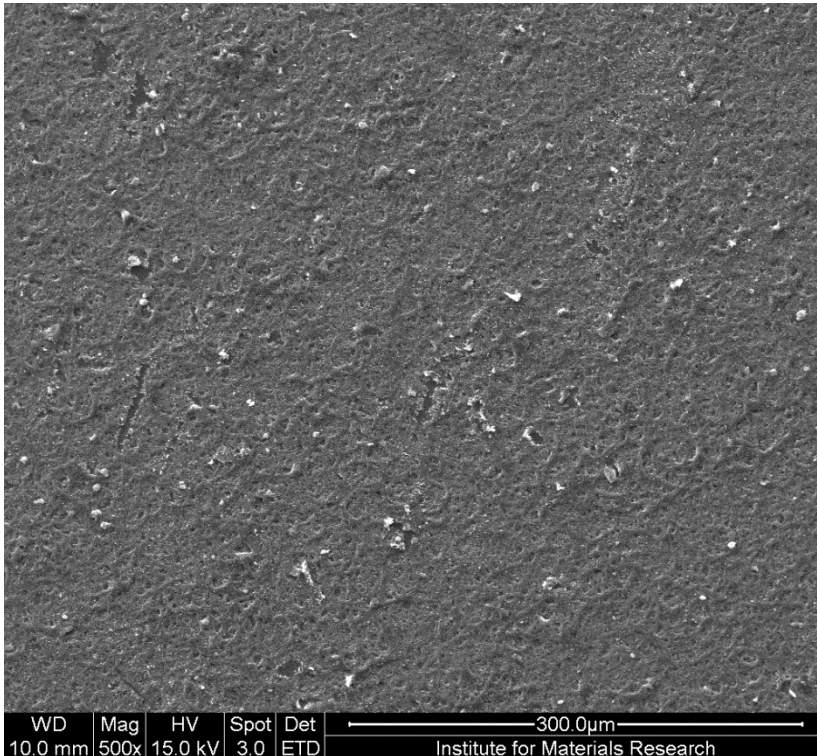




MULTI PASS – 30% ETHANOL, NOT WASHED,  
90°C, 0.2 ML/MIN, 3 PASSES, 4 WATTS

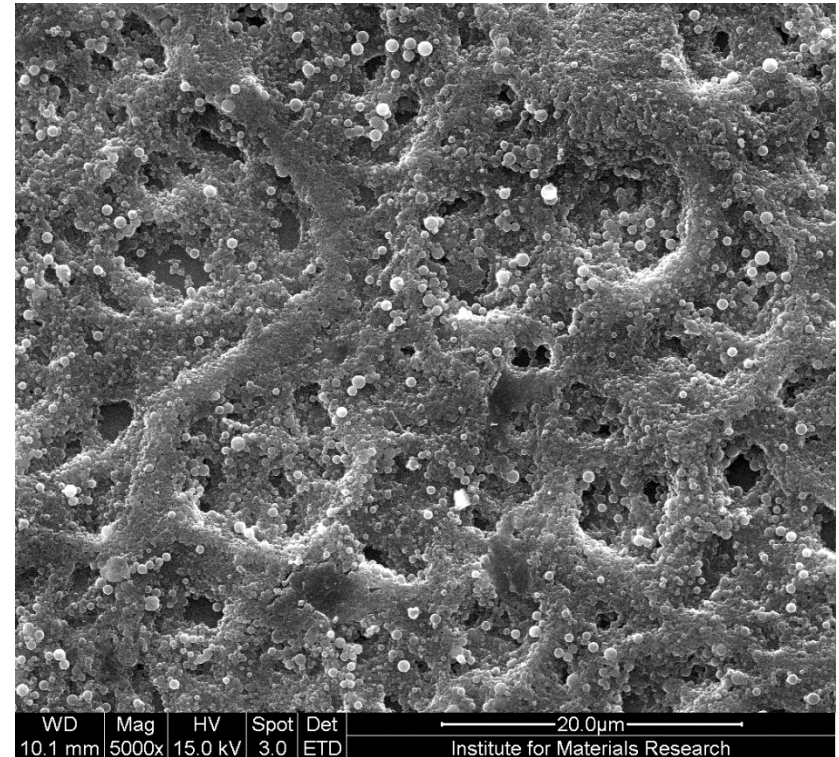
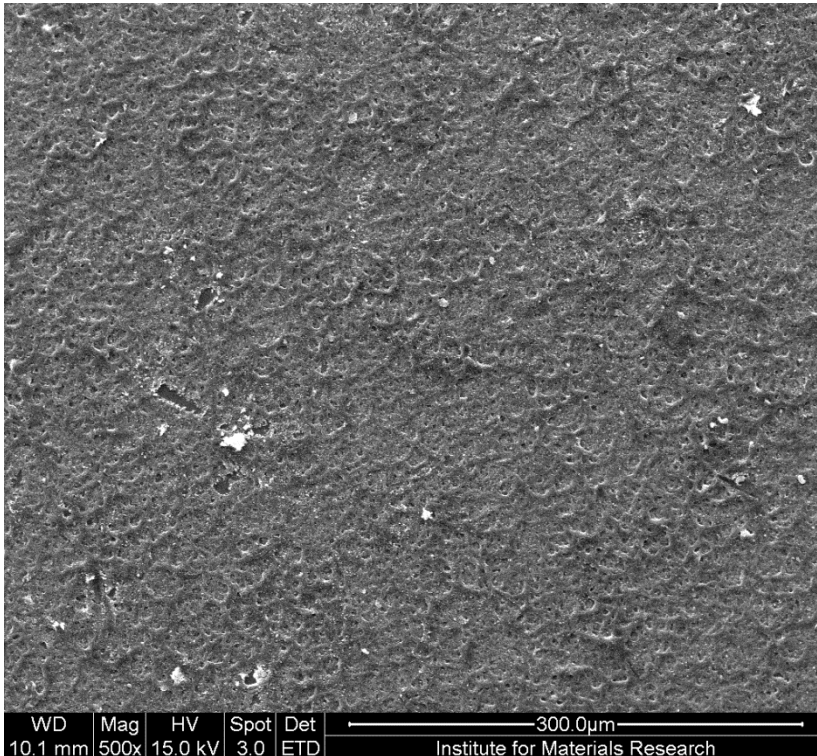


MULTI PASS – 30% ETHANOL, NOT WASHED,  
90°C, 0.2 ML/MIN, 5 PASSES, 4 WATTS



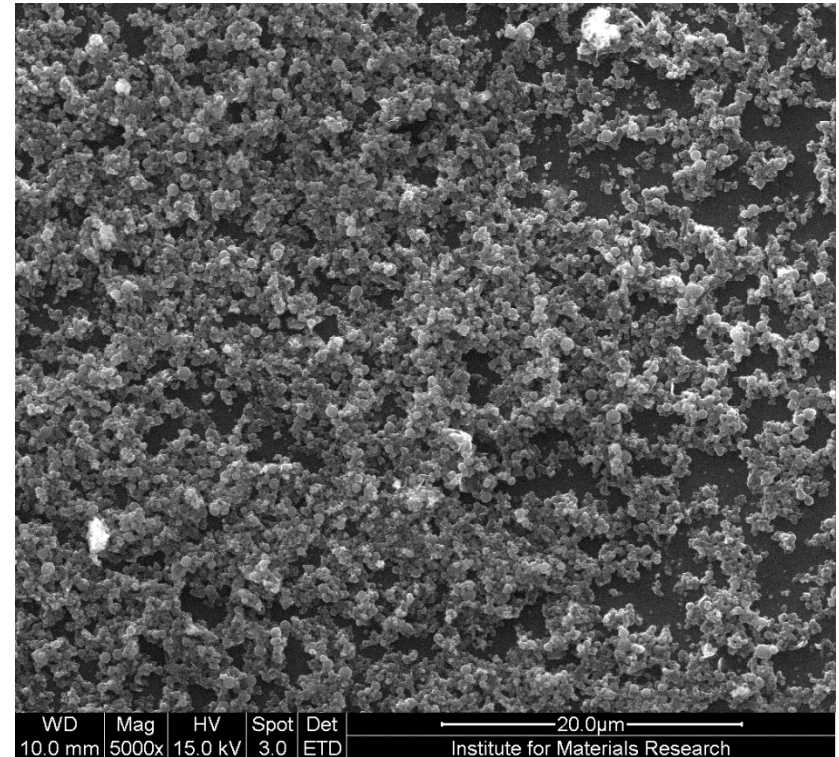
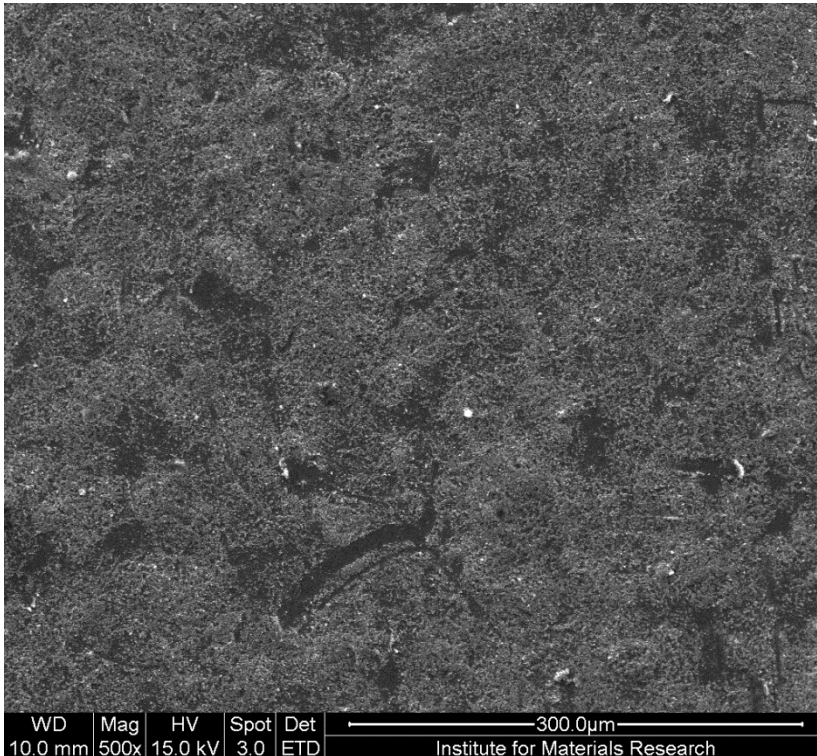


MULTI PASS – 30% ETHANOL, NOT WASHED,  
90°C, 0.2 ML/MIN, 10 PASSES, 4 WATTS



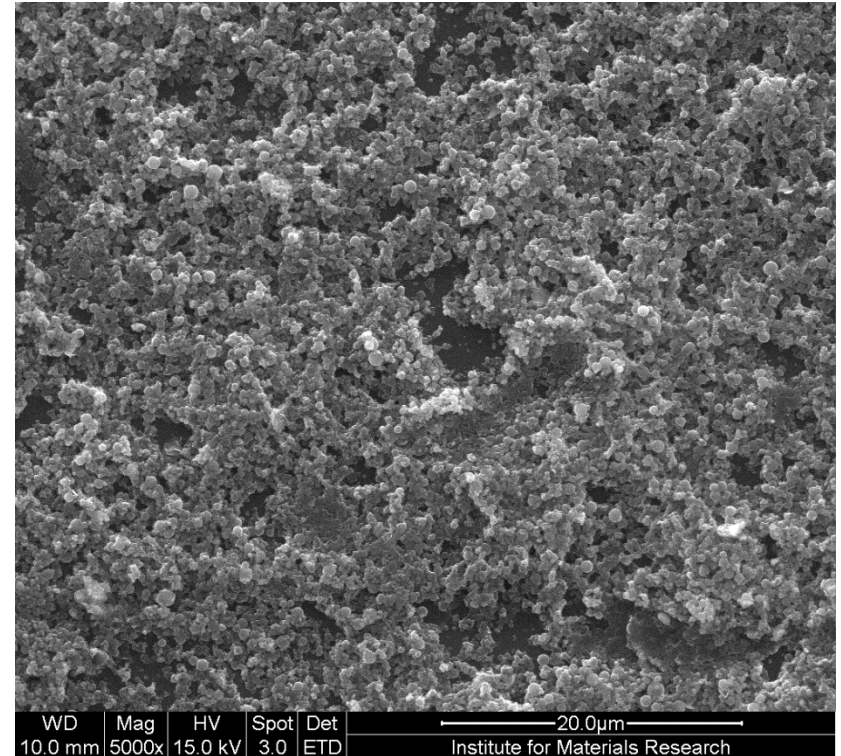
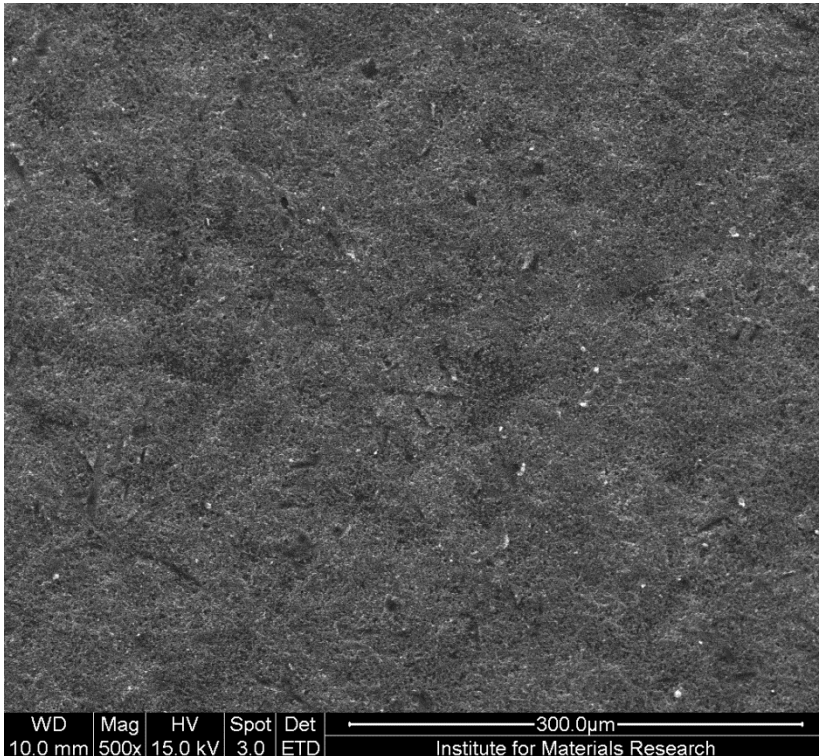


MULTI PASS – 70% ETHANOL, NOT WASHED,  
60°C, 0.1 ML/MIN, 5 PASSES, 4 WATTS



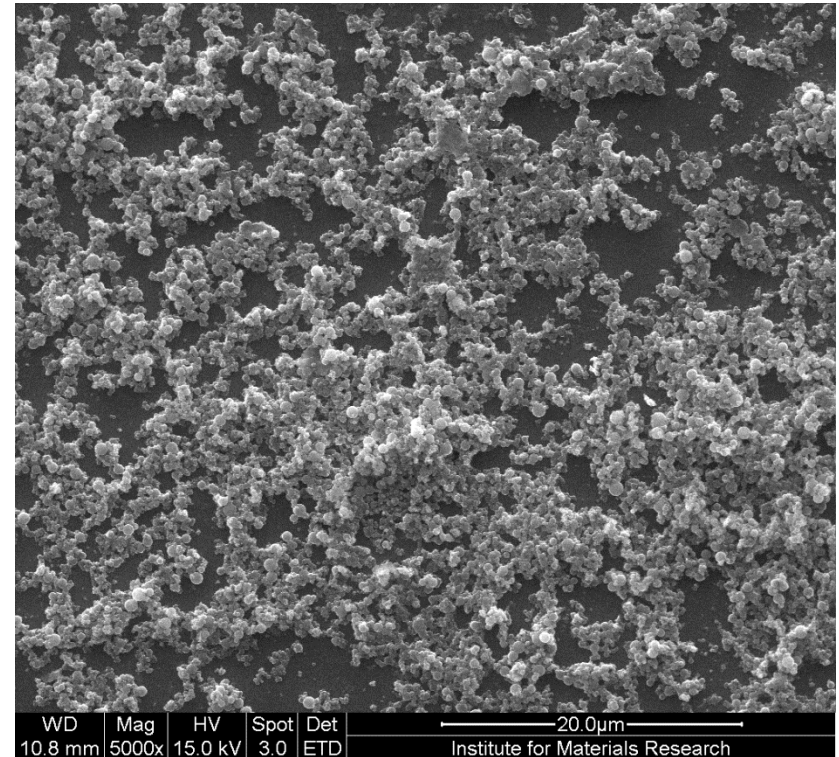
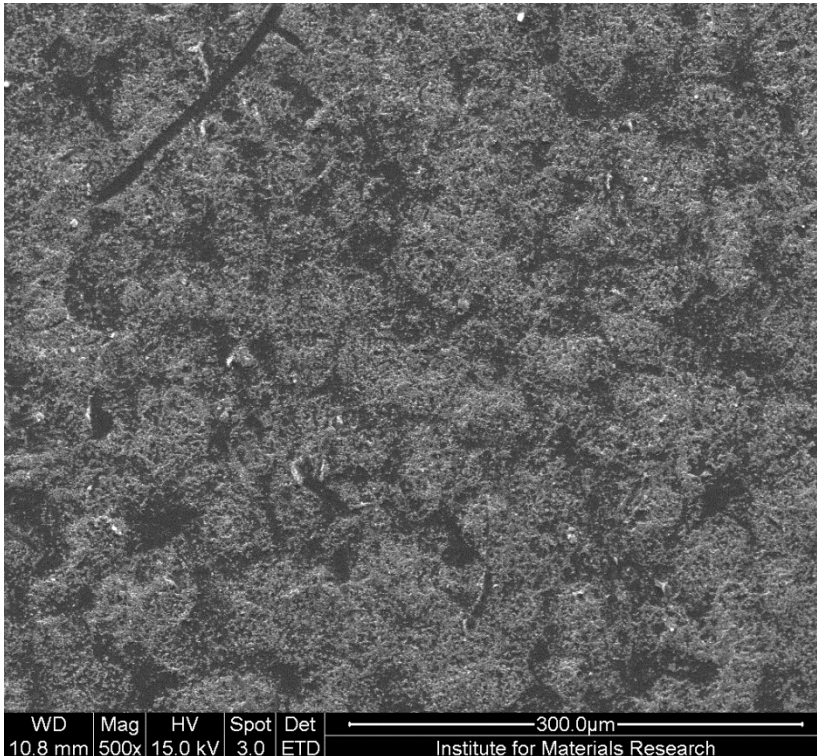


MULTI PASS – 70% ETHANOL, NOT WASHED,  
60°C, 0.1 ML/MIN, 10 PASSES, 4 WATTS



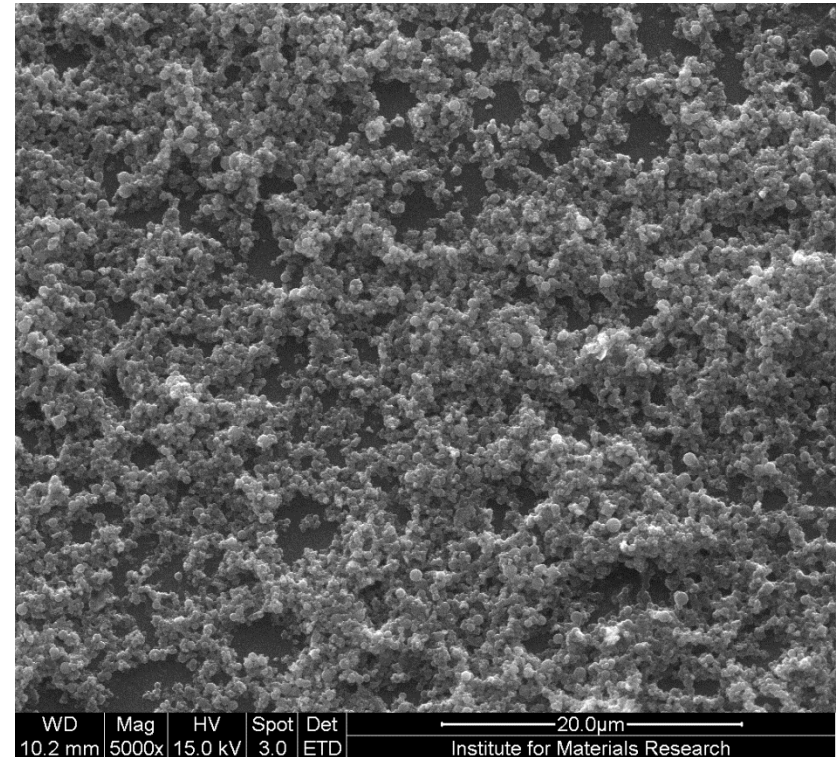
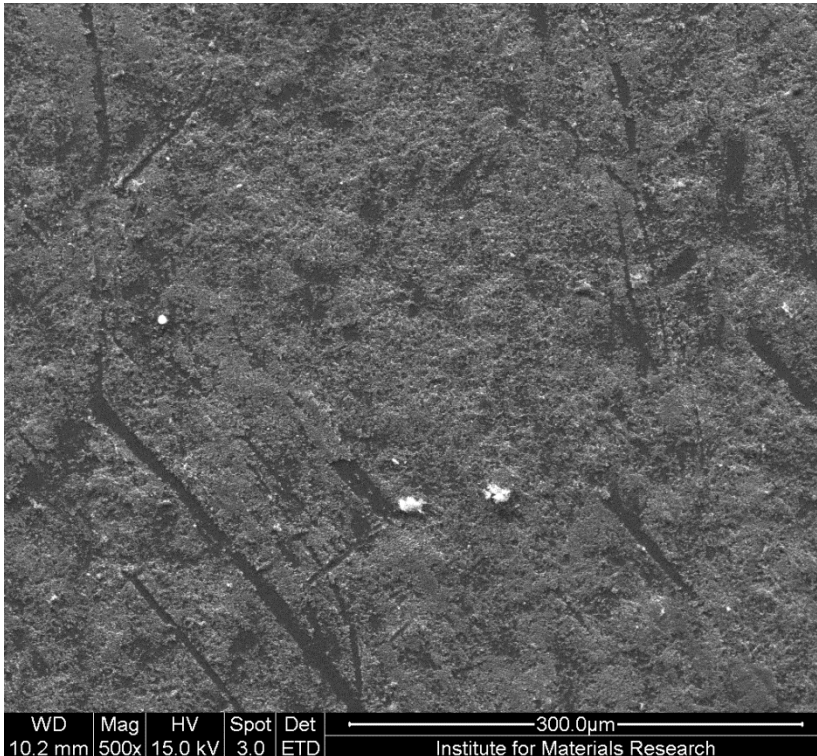


MULTI PASS – 70% ETHANOL, NOT WASHED,  
90°C, 0.1 ML/MIN, 5 PASSES, 4 WATTS

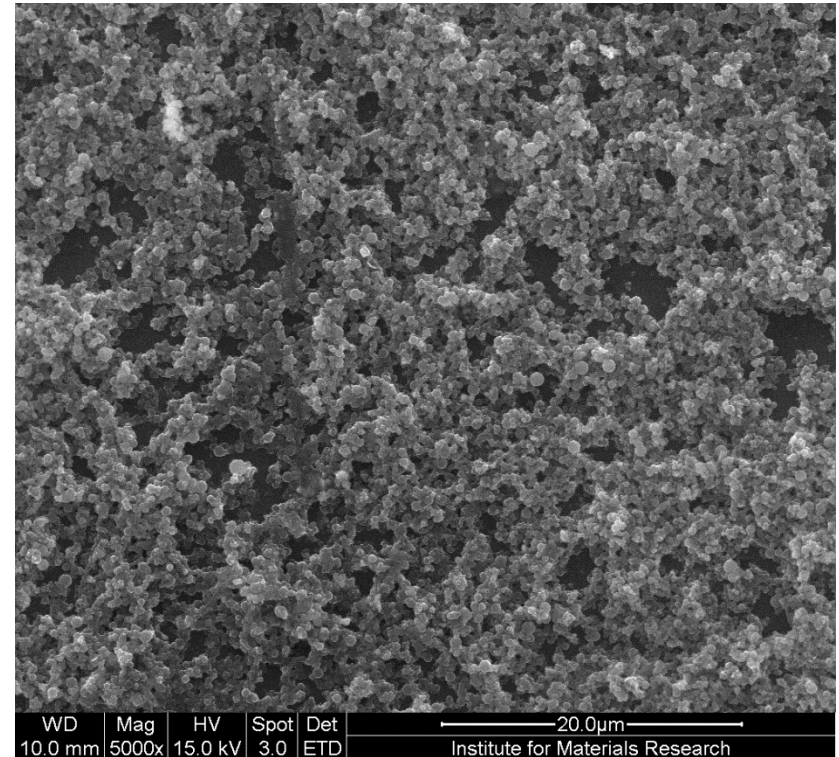
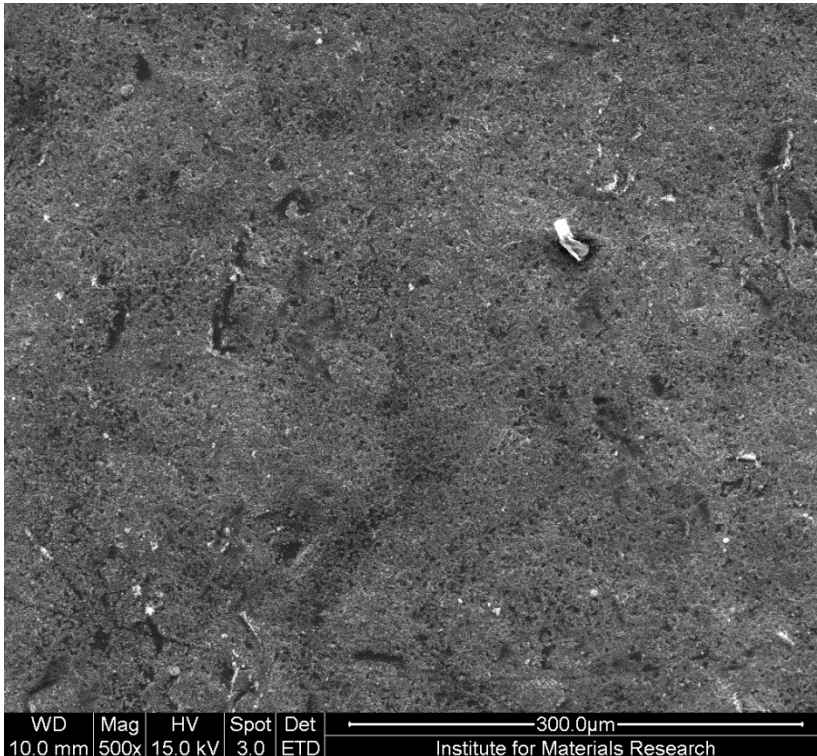




MULTI PASS – 70% ETHANOL, NOT WASHED,  
90°C, 0.1 ML/MIN, 10 PASSES, 4 WATTS

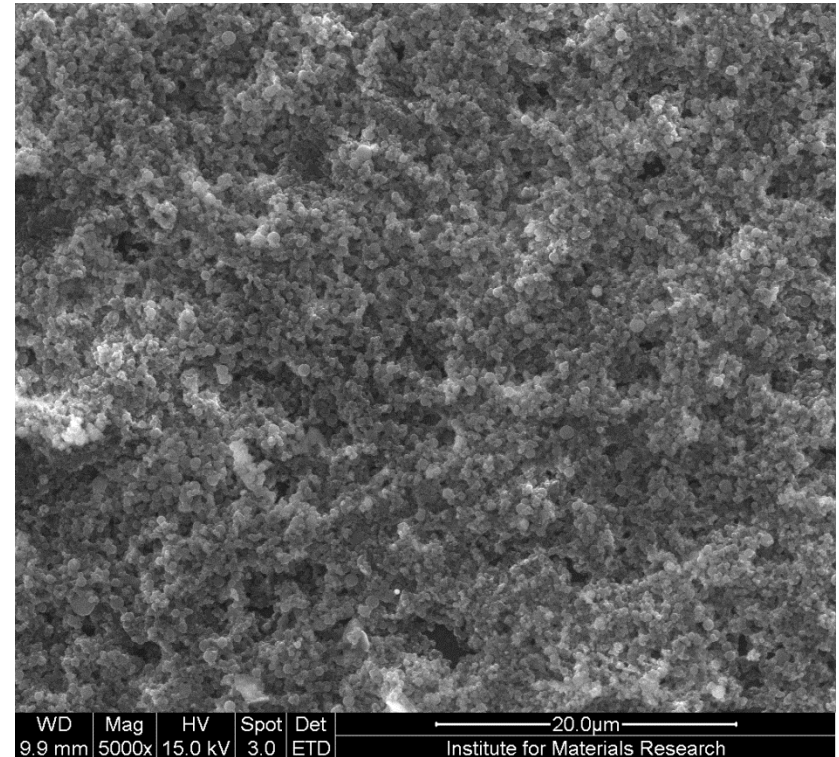
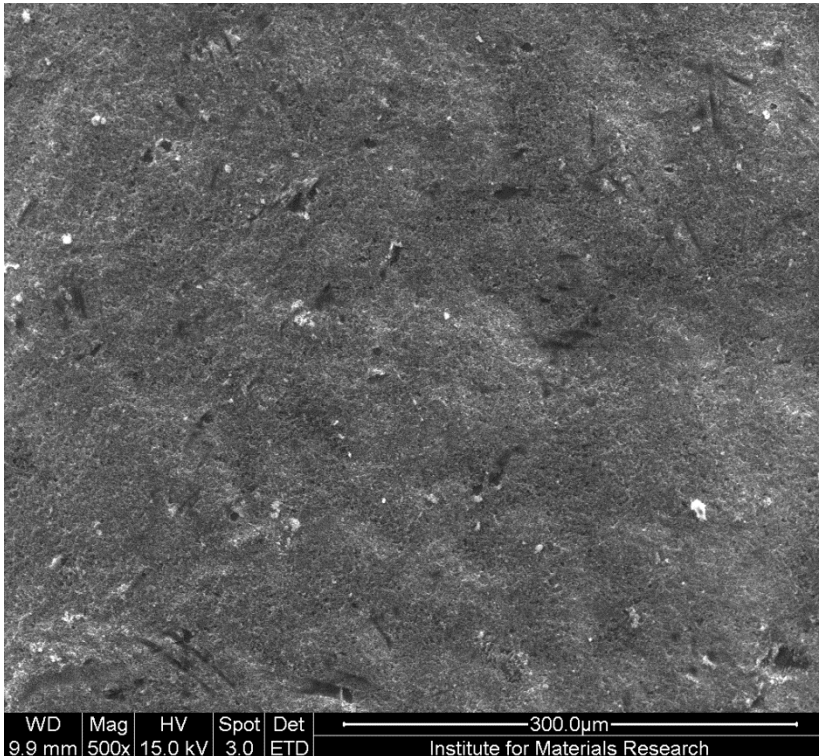


MULTI PASS – 70% ETHANOL, NOT WASHED,  
60°C, 0.2 ML/MIN, 3 PASSES, 4 WATTS

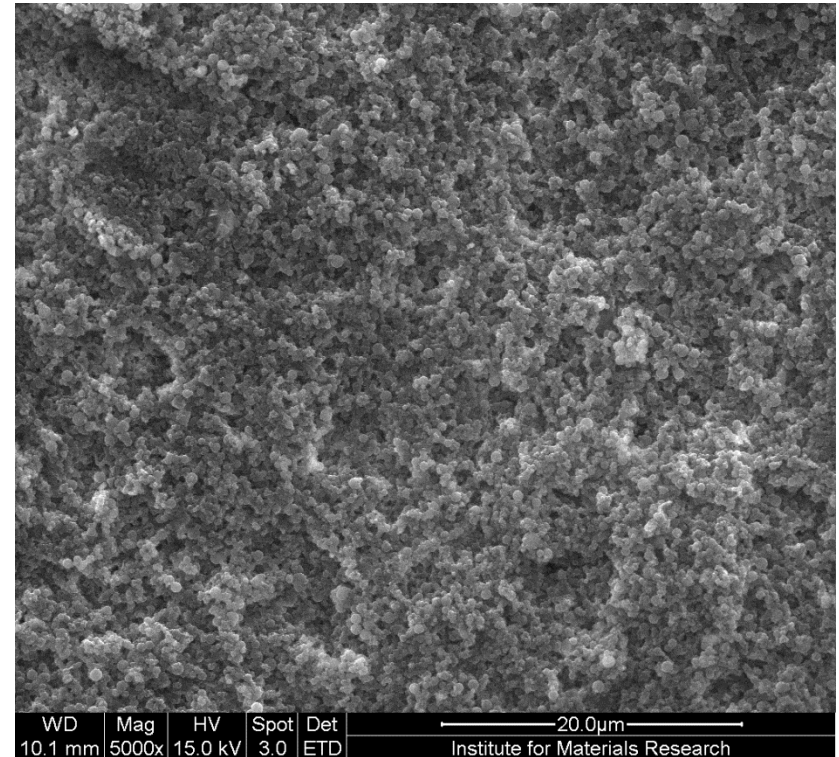
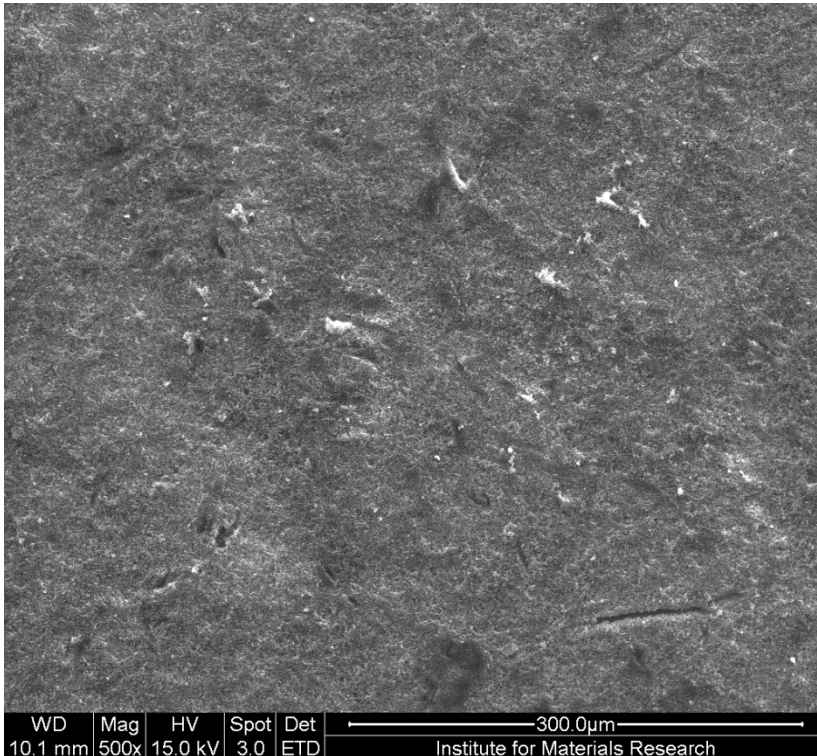




MULTI PASS – 70% ETHANOL, NOT WASHED,  
60°C, 0.2 ML/MIN, 5 PASSES, 4 WATTS

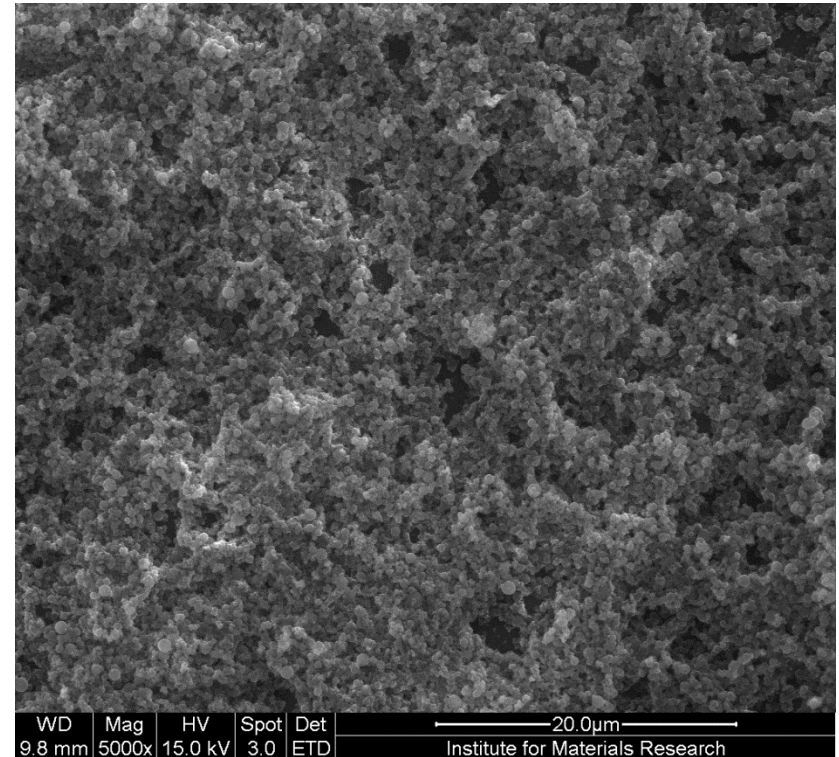
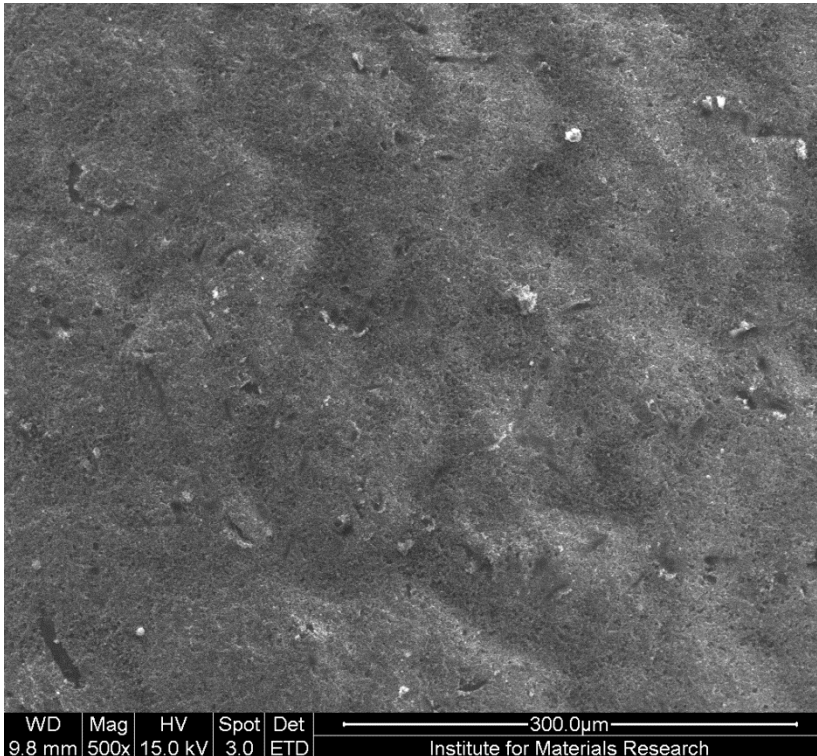


MULTI PASS – 70% ETHANOL, NOT WASHED,  
60°C, 0.2 ML/MIN, 10 PASSES, 4 WATTS

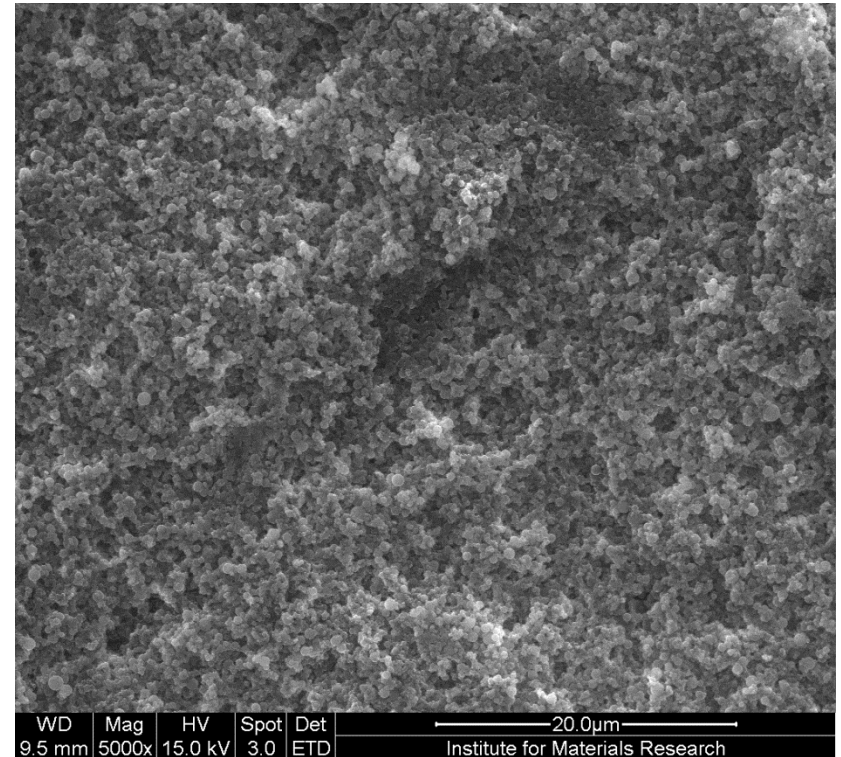
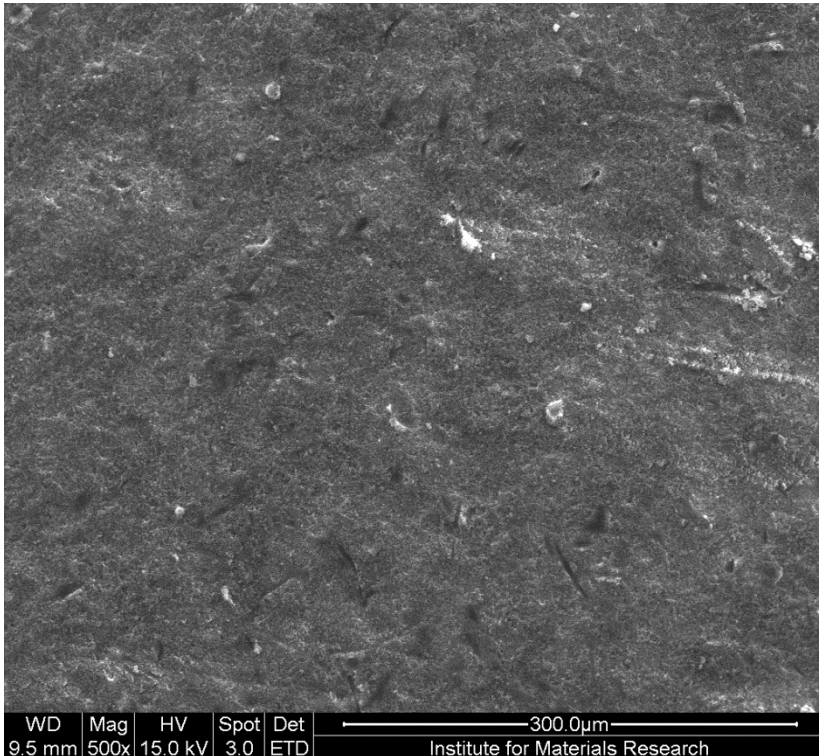




MULTI PASS – 70% ETHANOL, NOT WASHED,  
70°C, 0.2 ML/MIN, 5 PASSES, 4 WATTS

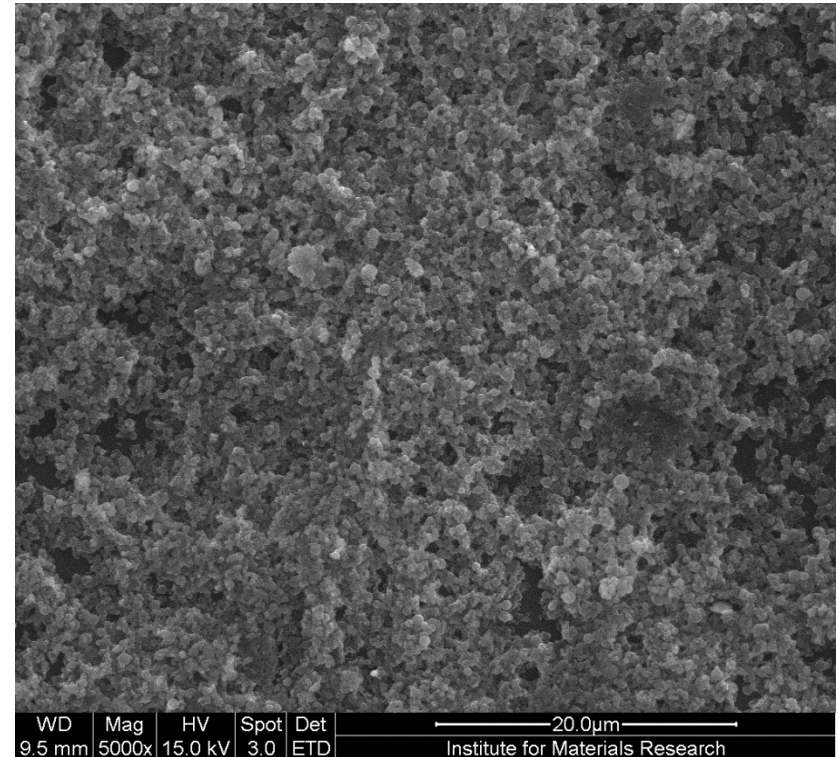
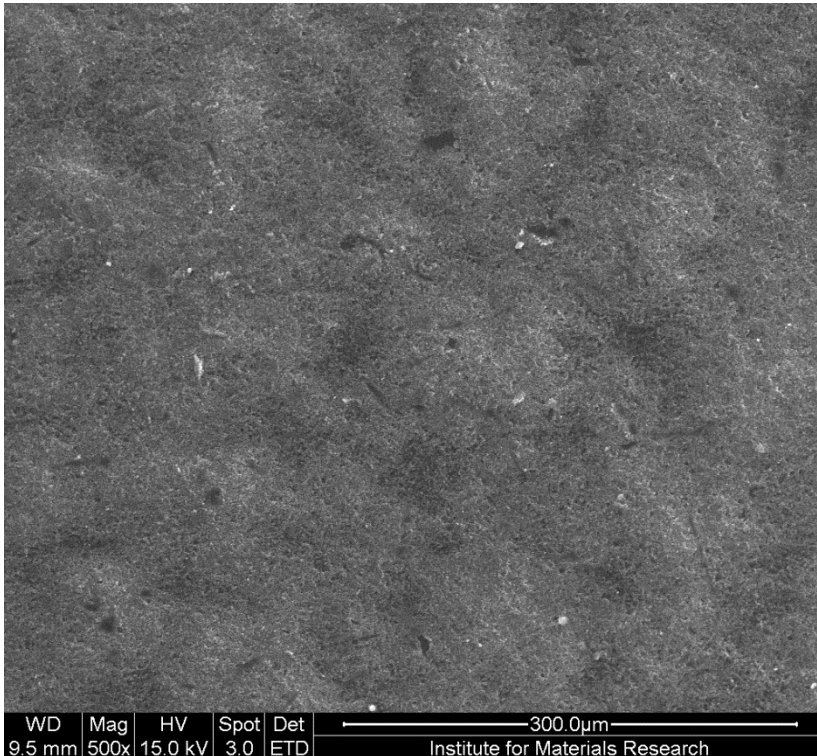


MULTI PASS – 70% ETHANOL, NOT WASHED,  
70°C, 0.2 ML/MIN, 10 PASSES, 4 WATTS

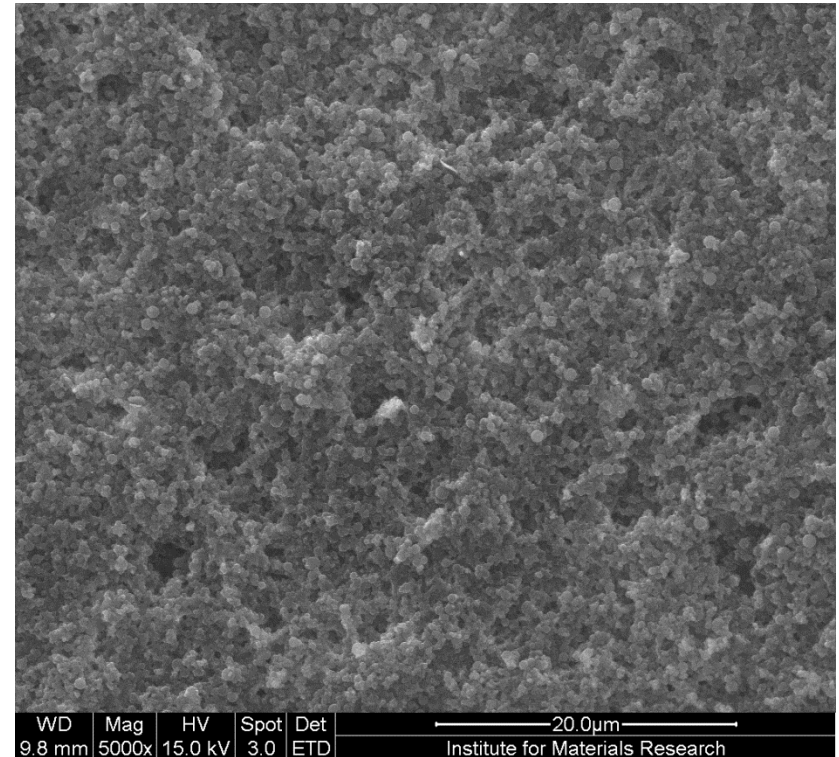
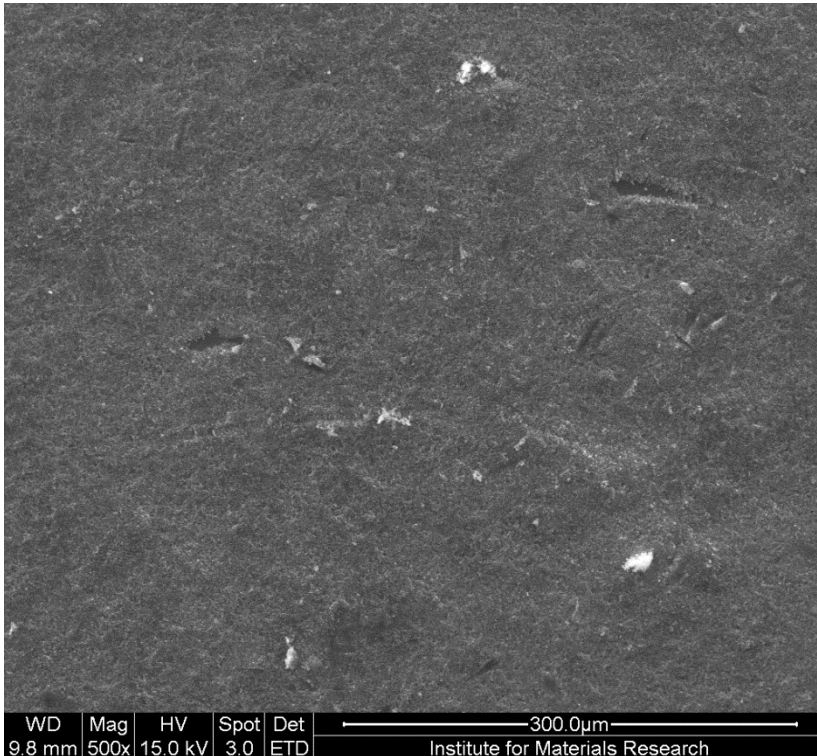




MULTI PASS – 70% ETHANOL, NOT WASHED,  
80°C, 0.2 ML/MIN, 5 PASSES, 4 WATTS

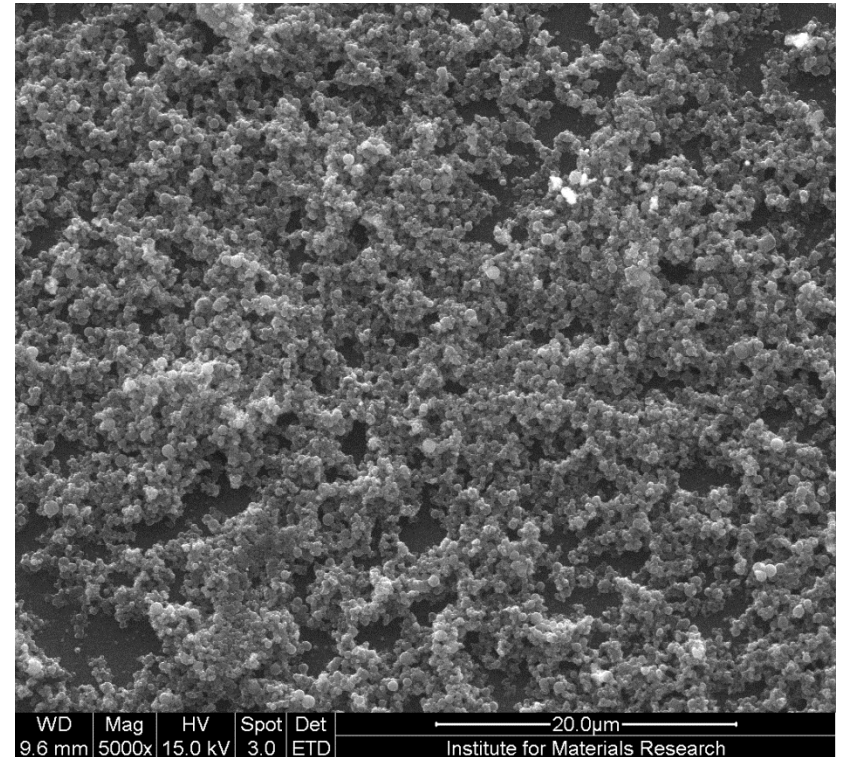
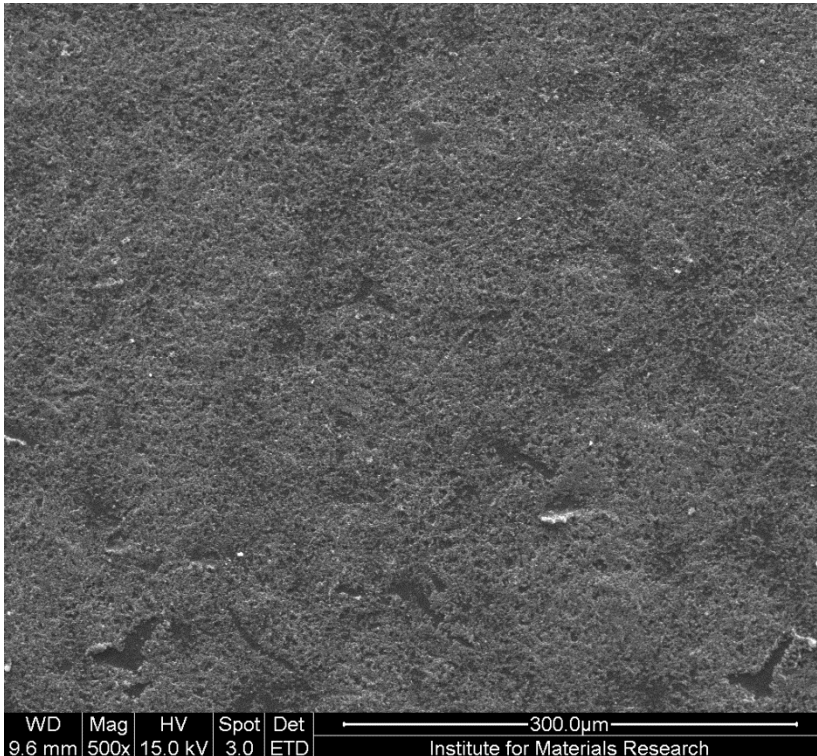


MULTI PASS – 70% ETHANOL, NOT WASHED,  
80°C, 0.2 ML/MIN, 10 PASSES, 4 WATTS

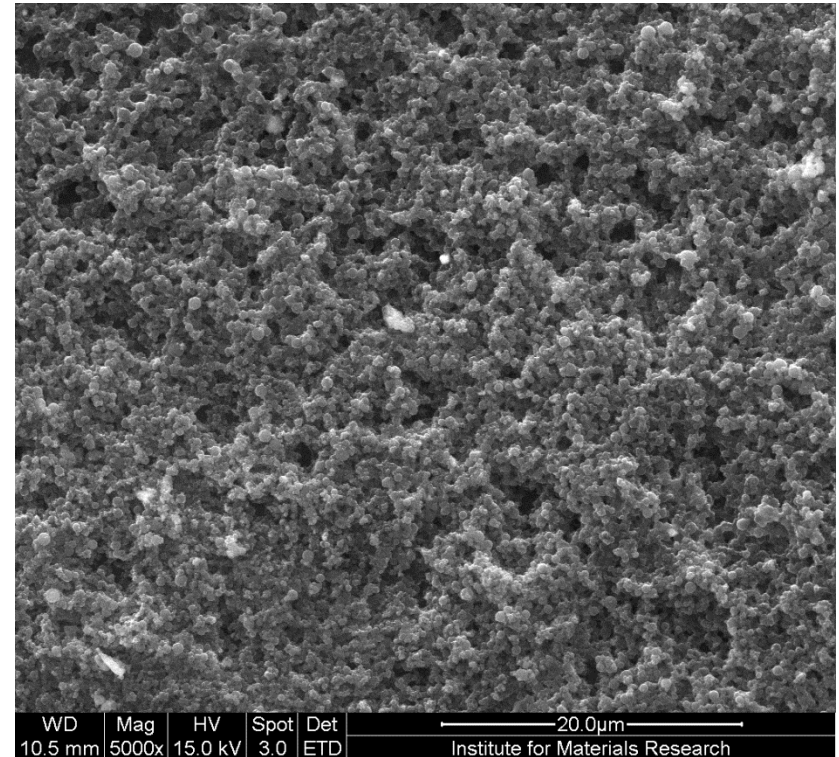
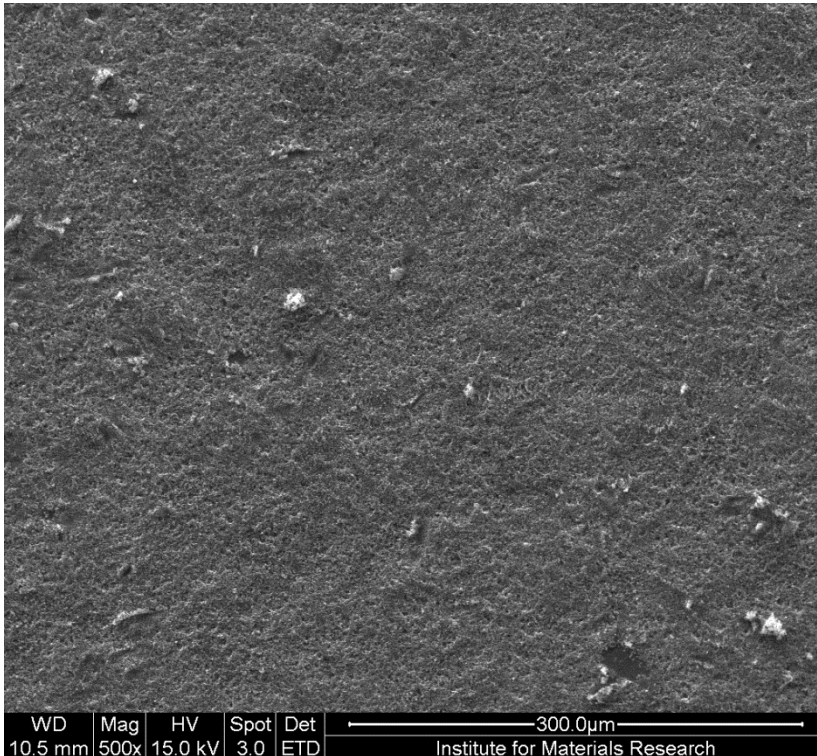




MULTI PASS – 70% ETHANOL, NOT WASHED,  
90°C, 0.2 ML/MIN, 3 PASSES, 4 WATTS

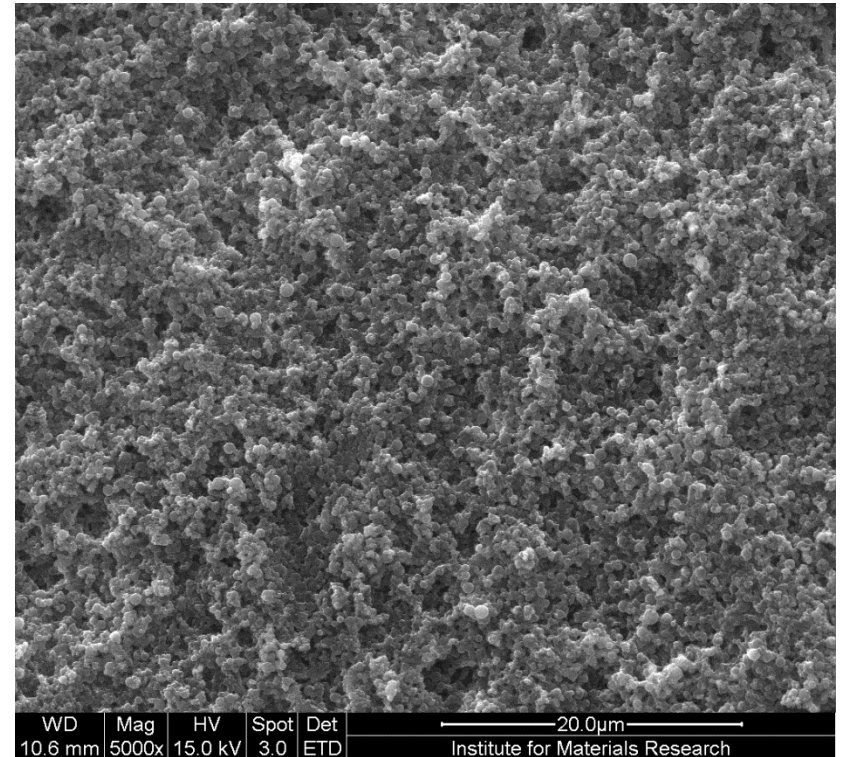
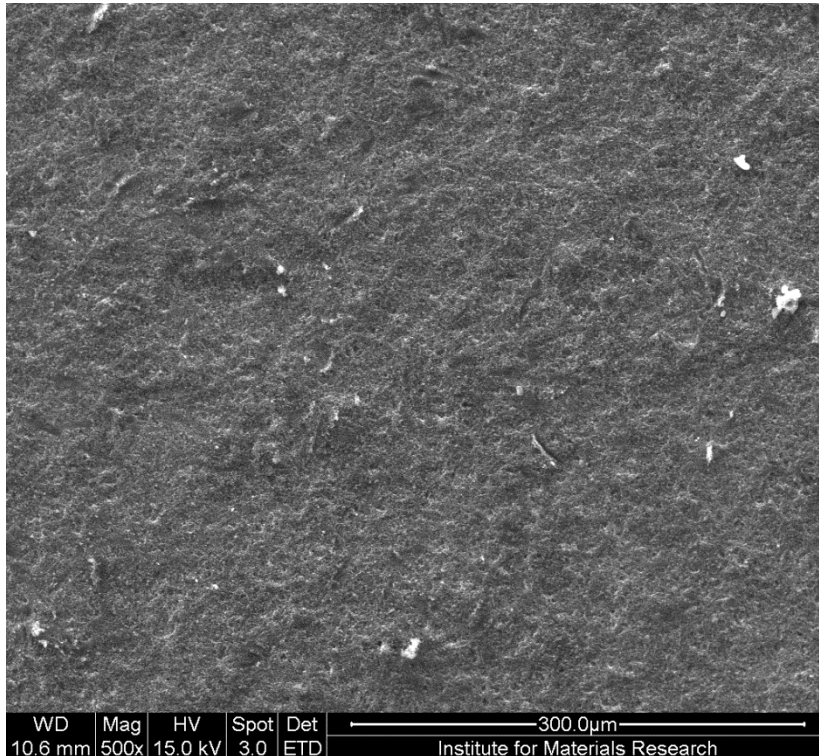


MULTI PASS – 70% ETHANOL, NOT WASHED,  
90°C, 0.2 ML/MIN, 5 PASSES, 4 WATTS





MULTI PASS – 70% ETHANOL, NOT WASHED,  
90°C, 0.2 ML/MIN, 10 PASSES, 4 WATTS

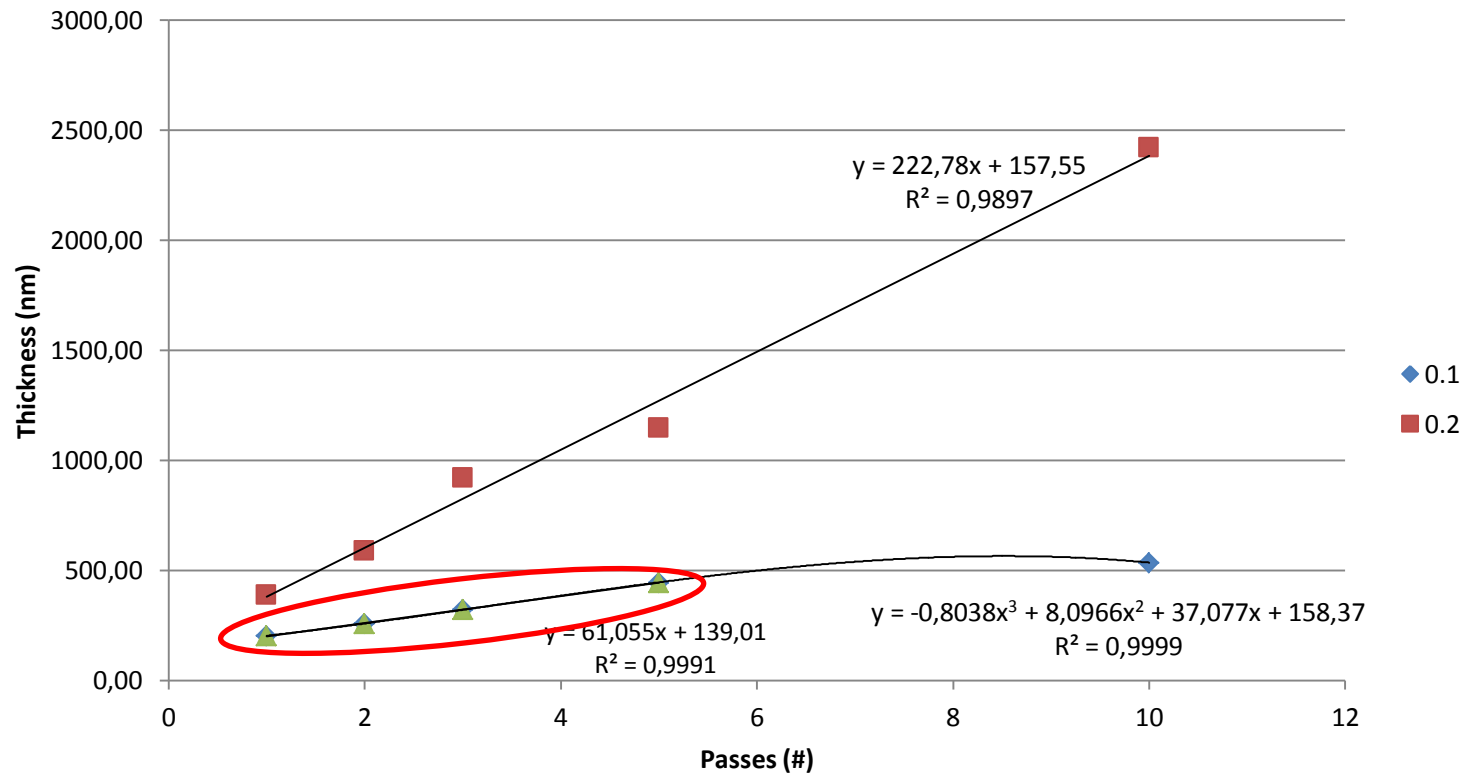


The left side of the slide features a decorative vertical stripe with a gradient from light to dark grey. To the right of this stripe are several vertical lines of varying thicknesses. A cluster of five dark blue circles of different sizes is positioned to the left of the main text.

# THICKNESS

# THICKNESS – 30% ETHANOL, 60°C

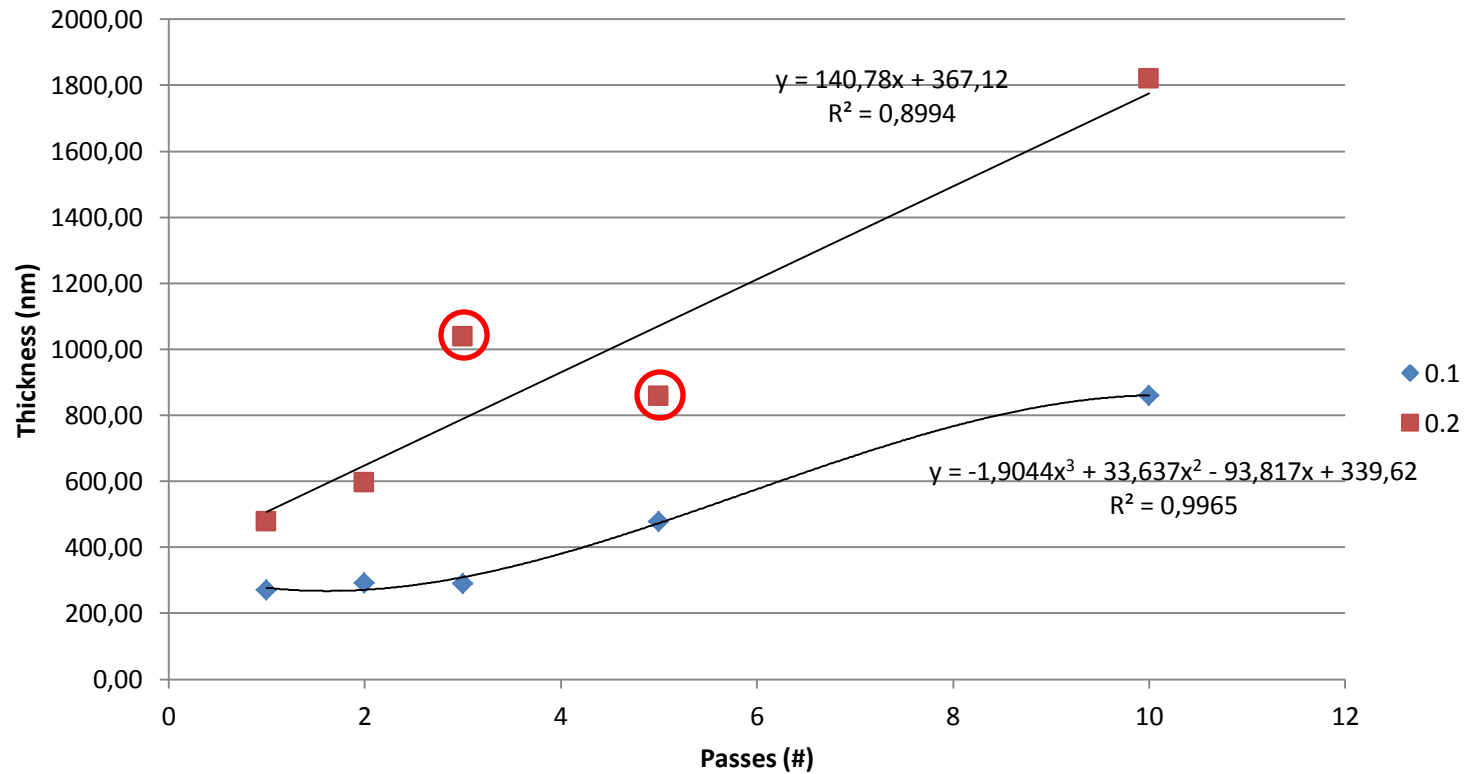
30% - 60°C





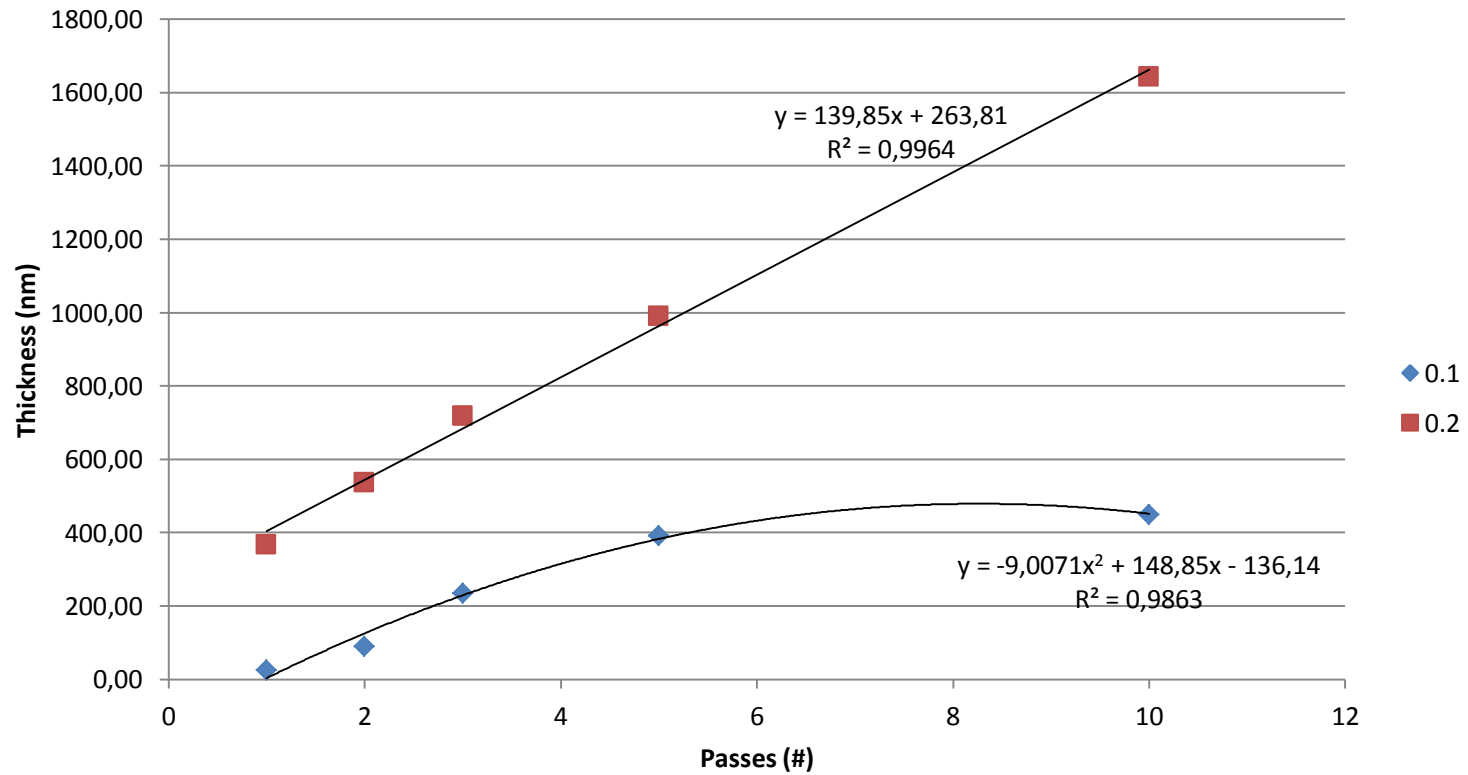
# THICKNESS – 30% ETHANOL, 70°C

30% - 70°C



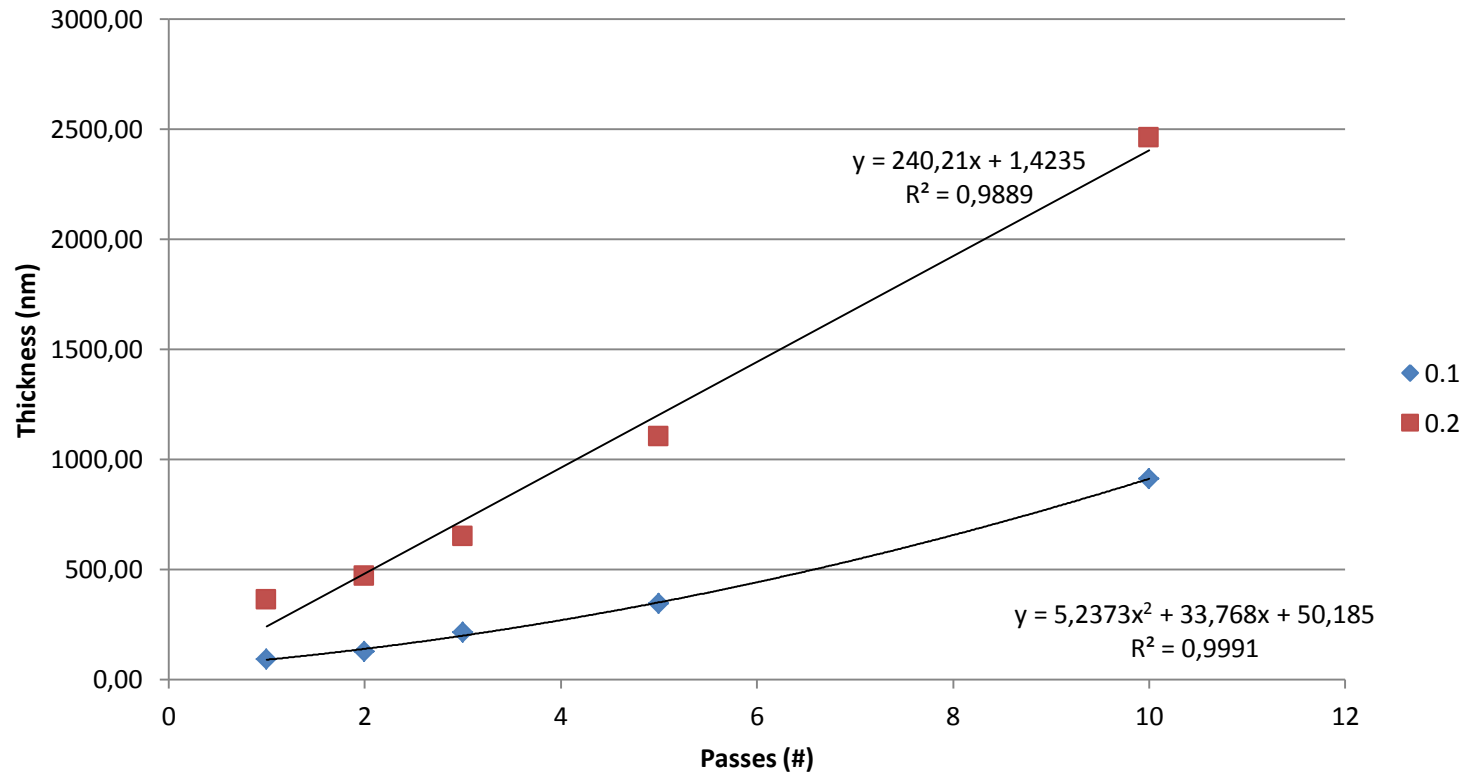
# THICKNESS – 30% ETHANOL, 80°C

30% - 80°C



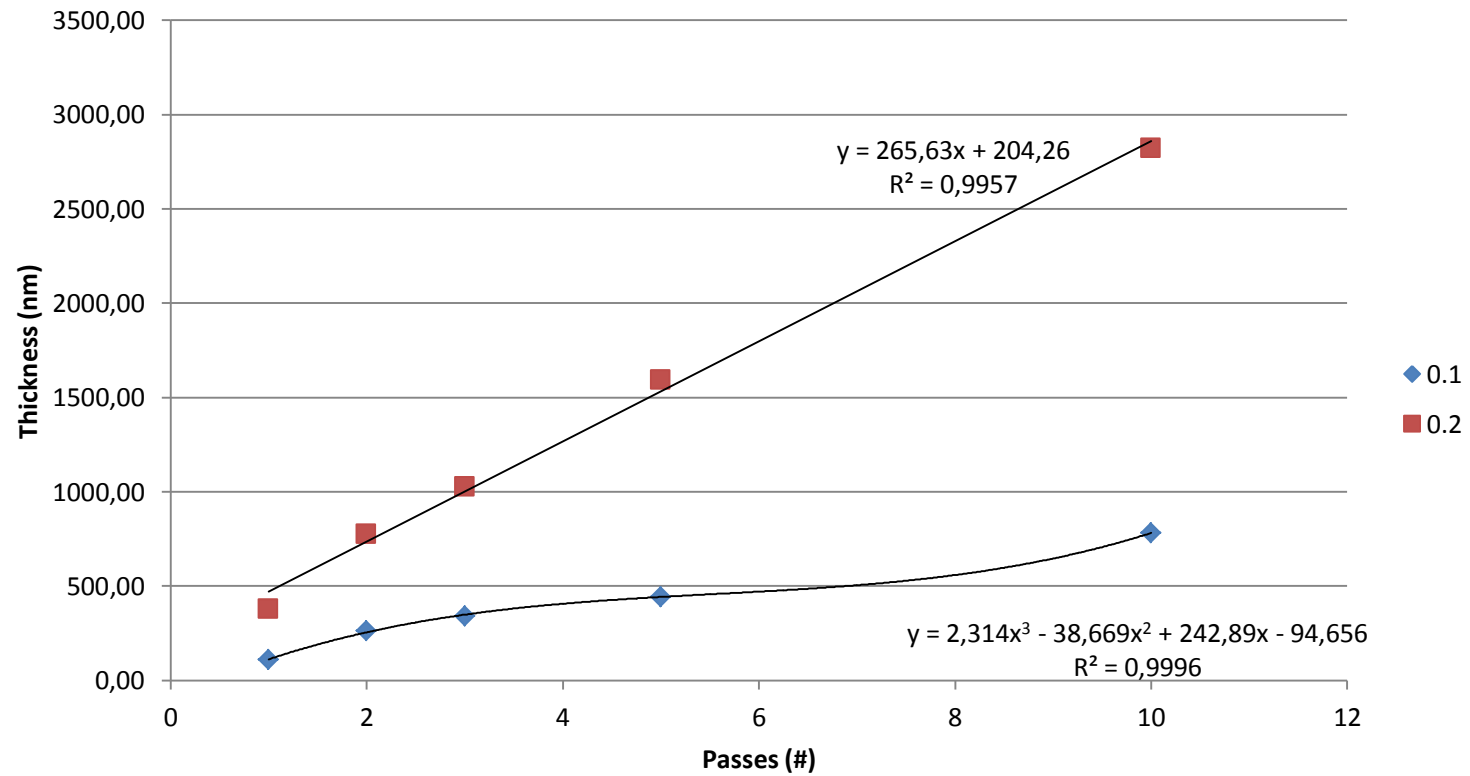
# THICKNESS – 30% ETHANOL, 90°C

30% - 90°C



# THICKNESS – 70% ETHANOL, 60°C

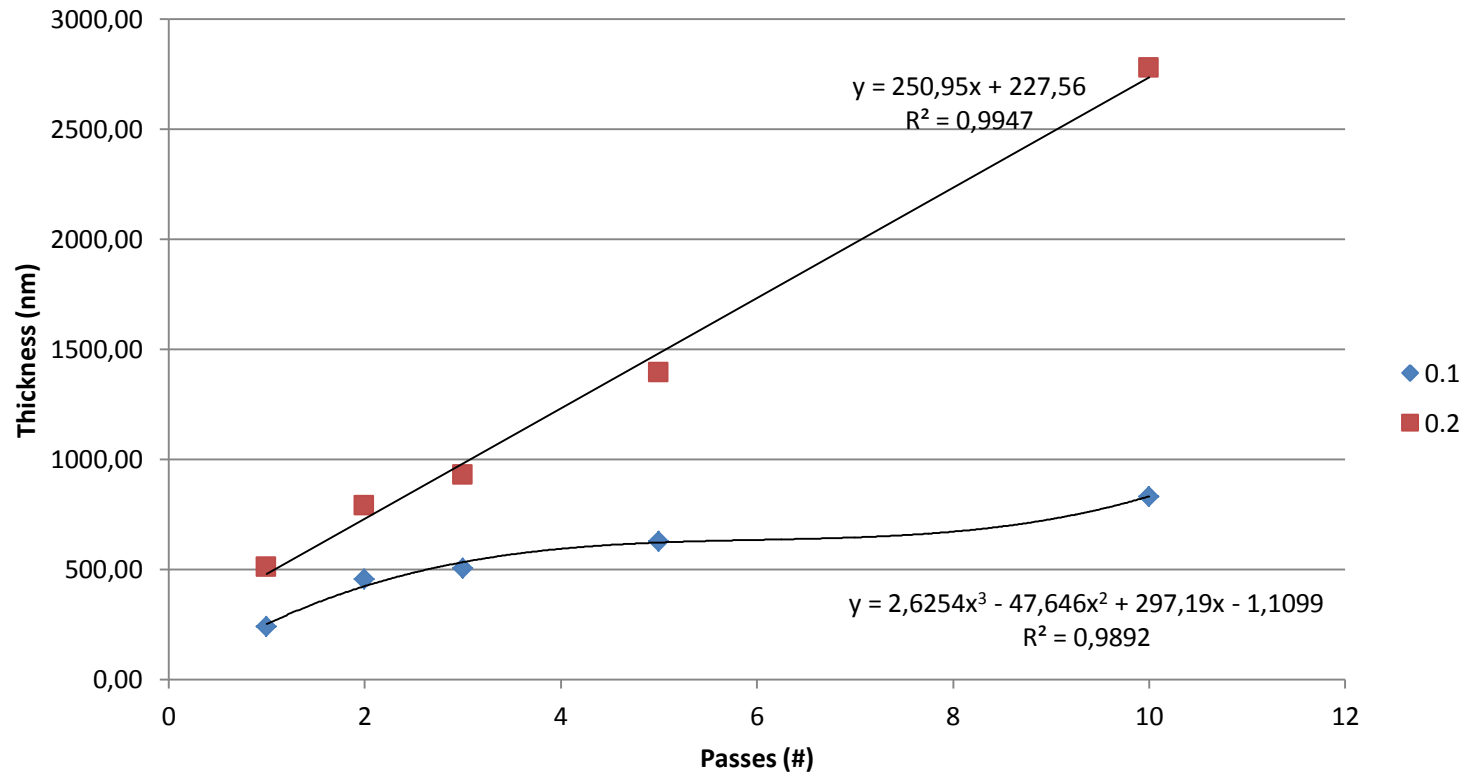
70% - 60°C





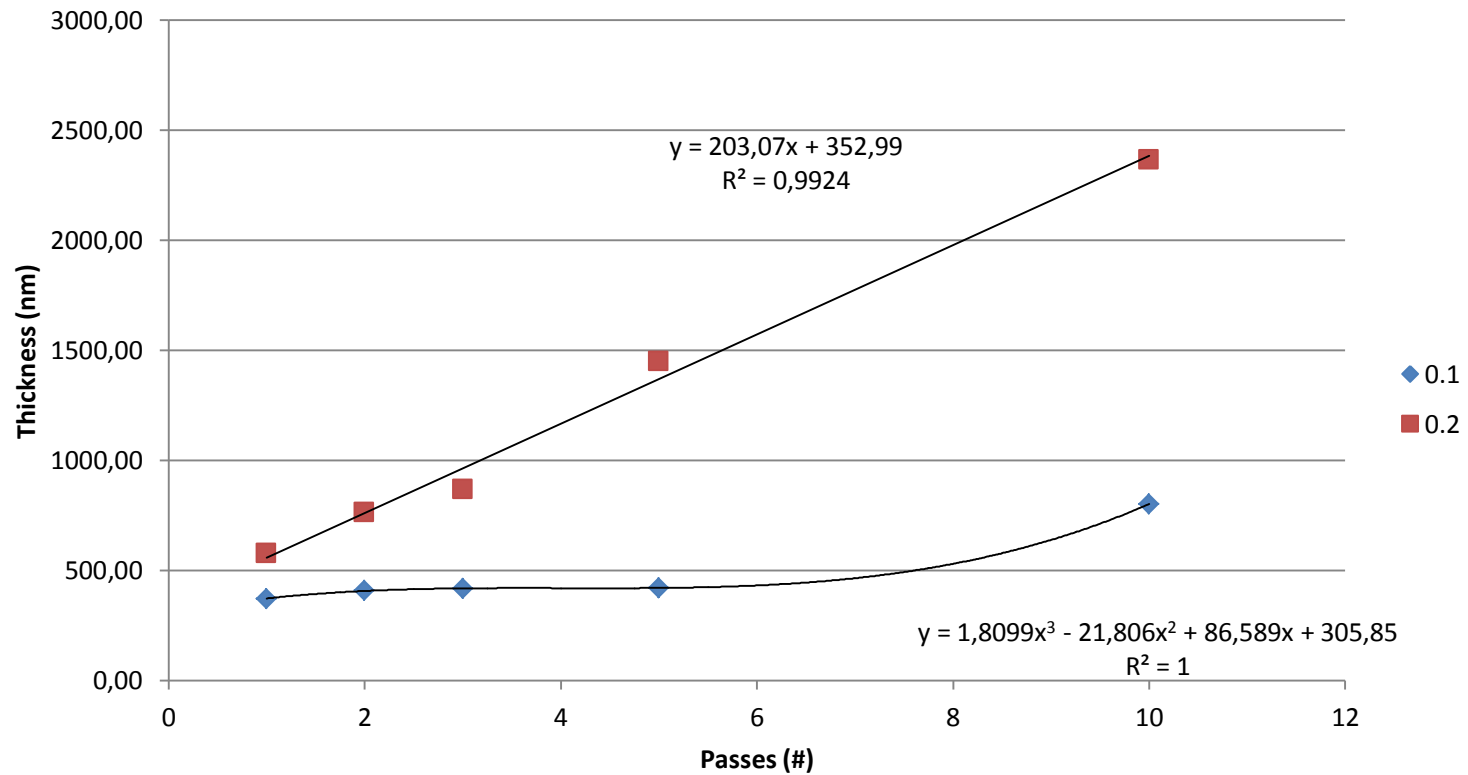
# THICKNESS – 70% ETHANOL, 70°C

70% - 70°C



# THICKNESS – 70% ETHANOL, 80°C

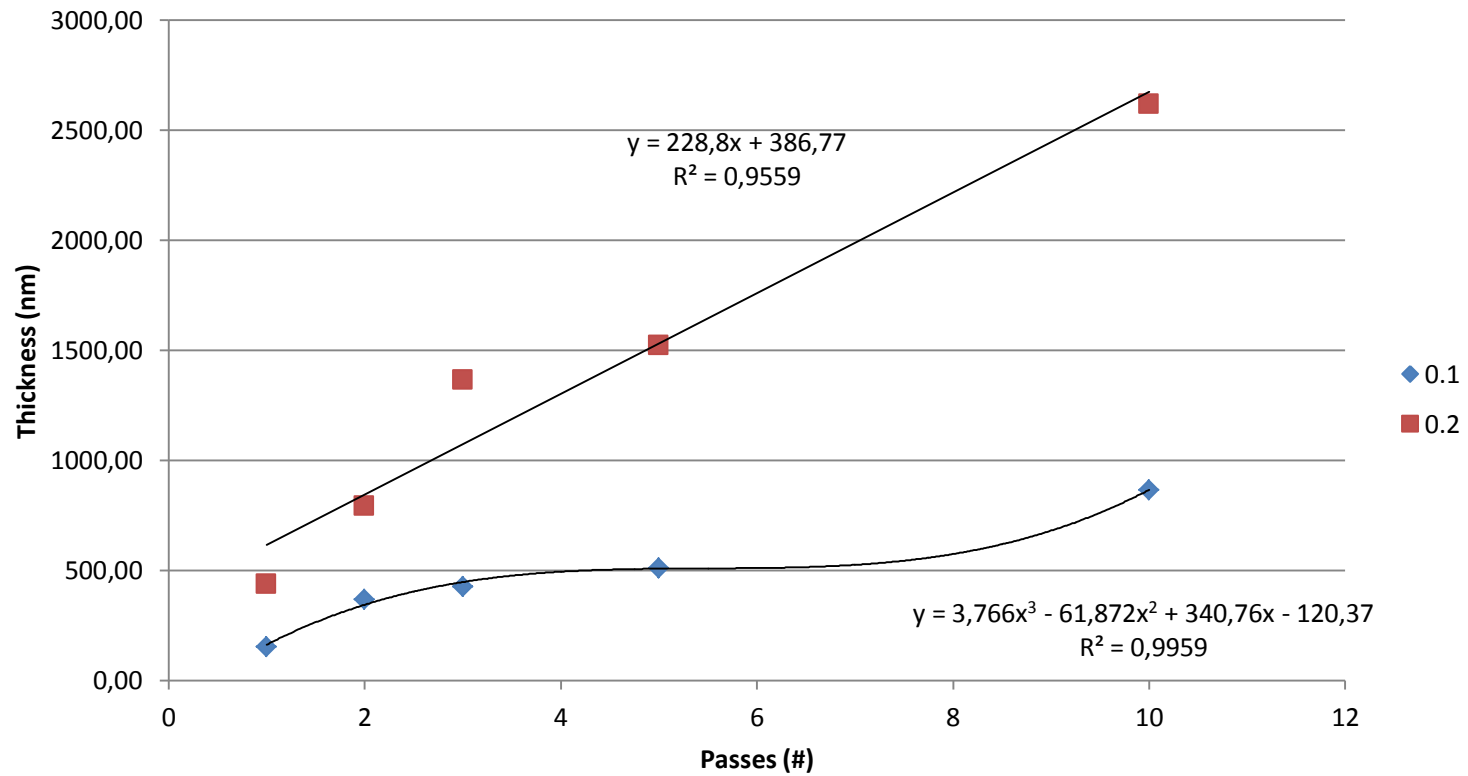
70% - 80°C





# THICKNESS – 70% ETHANOL, 90°C

70% - 90°C



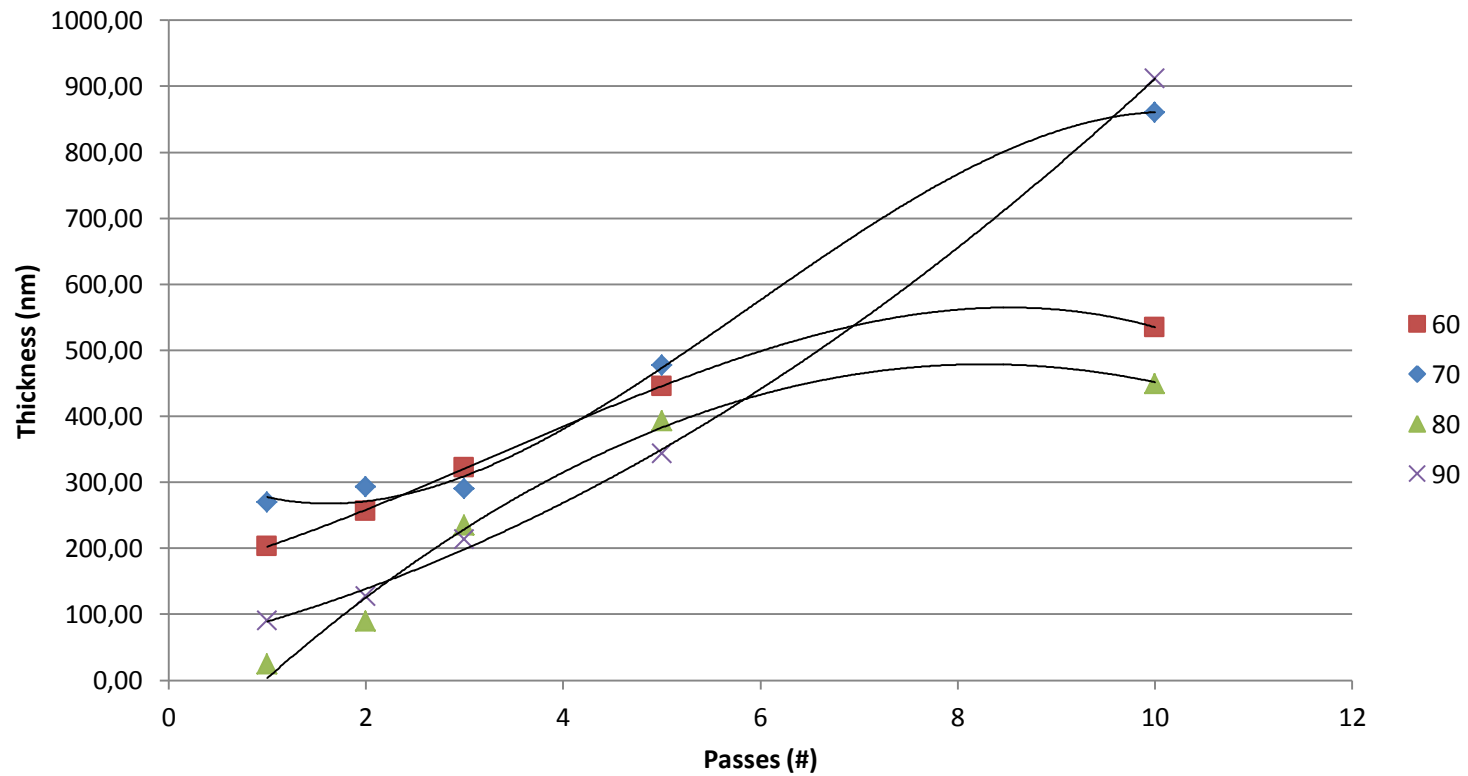
# THICKNESS

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



# THICKNESS – 30% ETHANOL

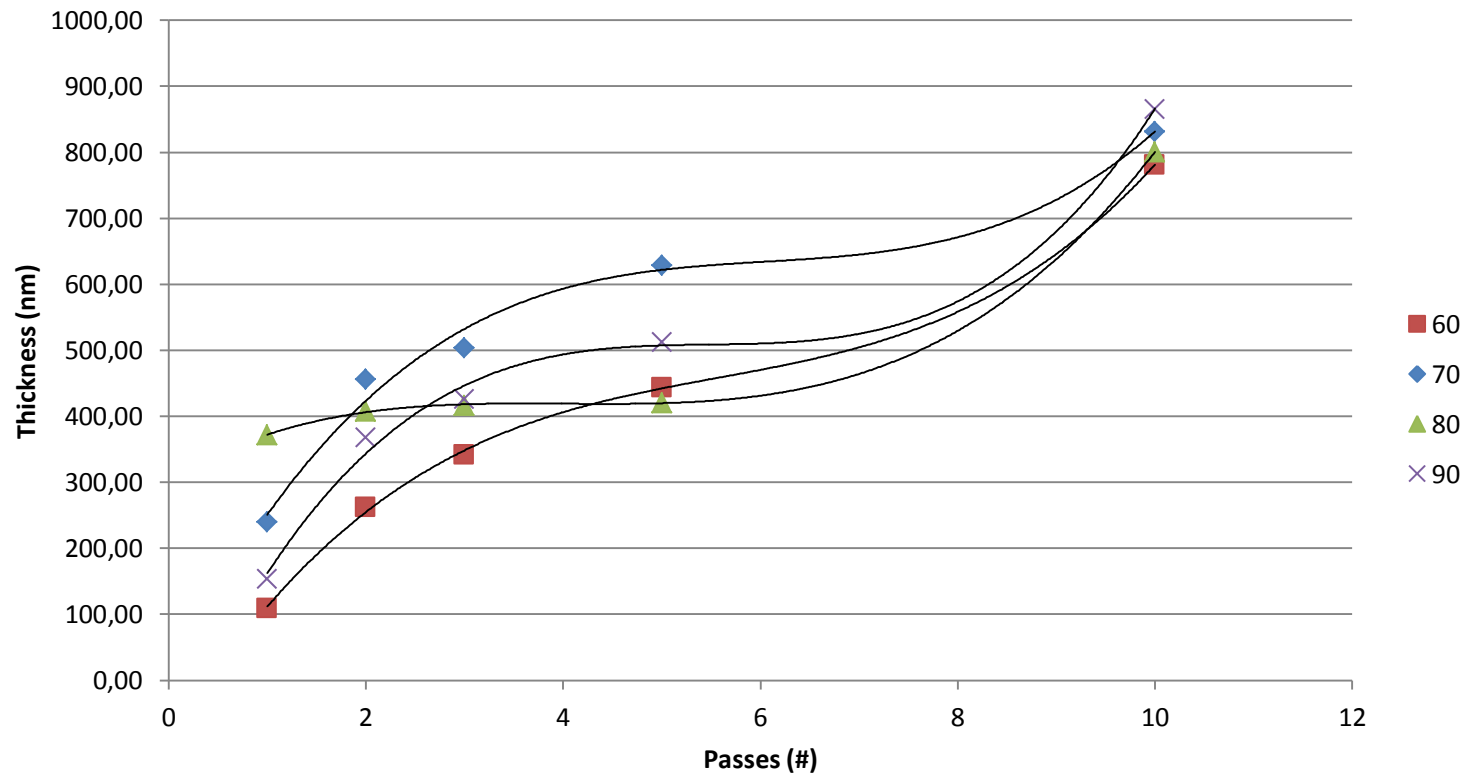
30% - 0.1ml/min





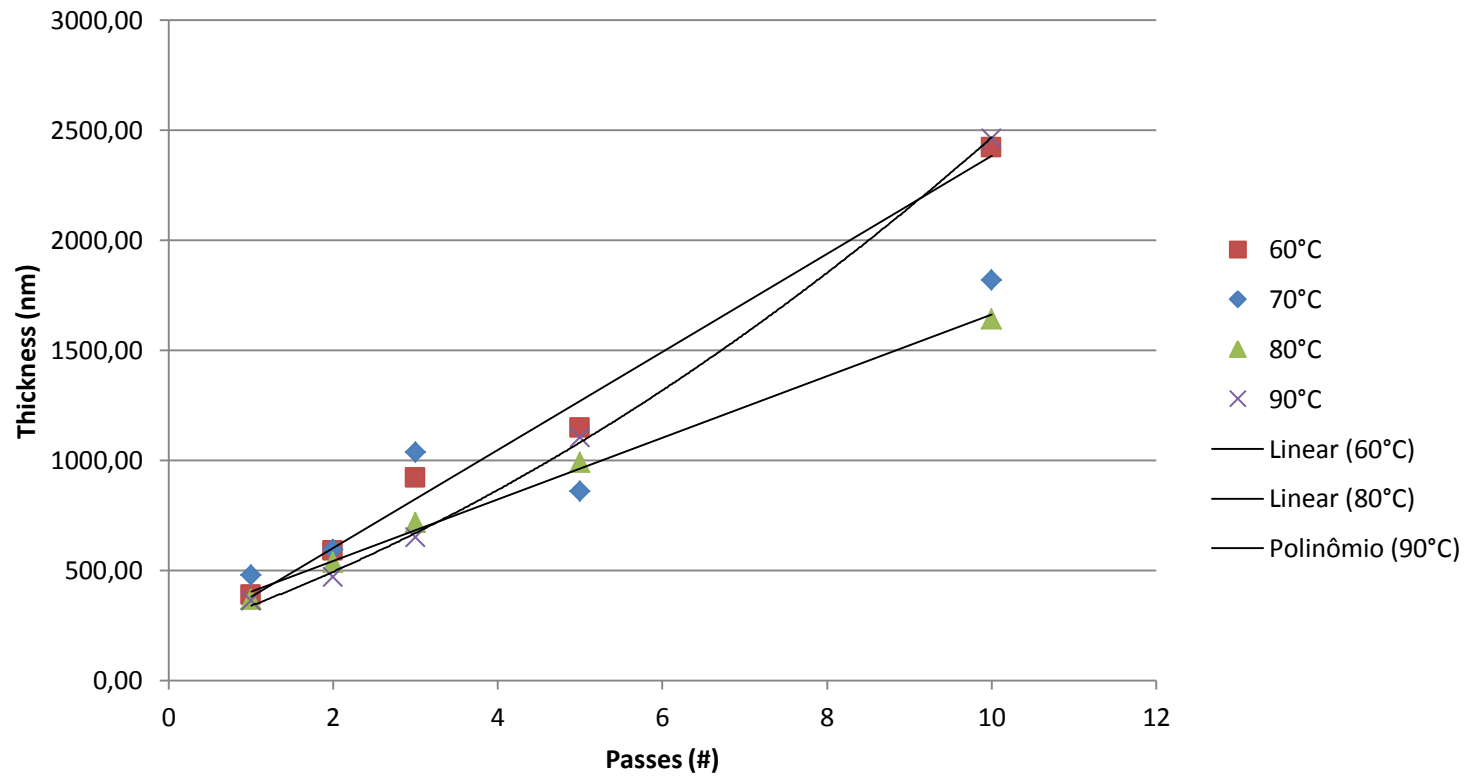
# THICKNESS – 70% ETHANOL

70% - 0.1ml/min



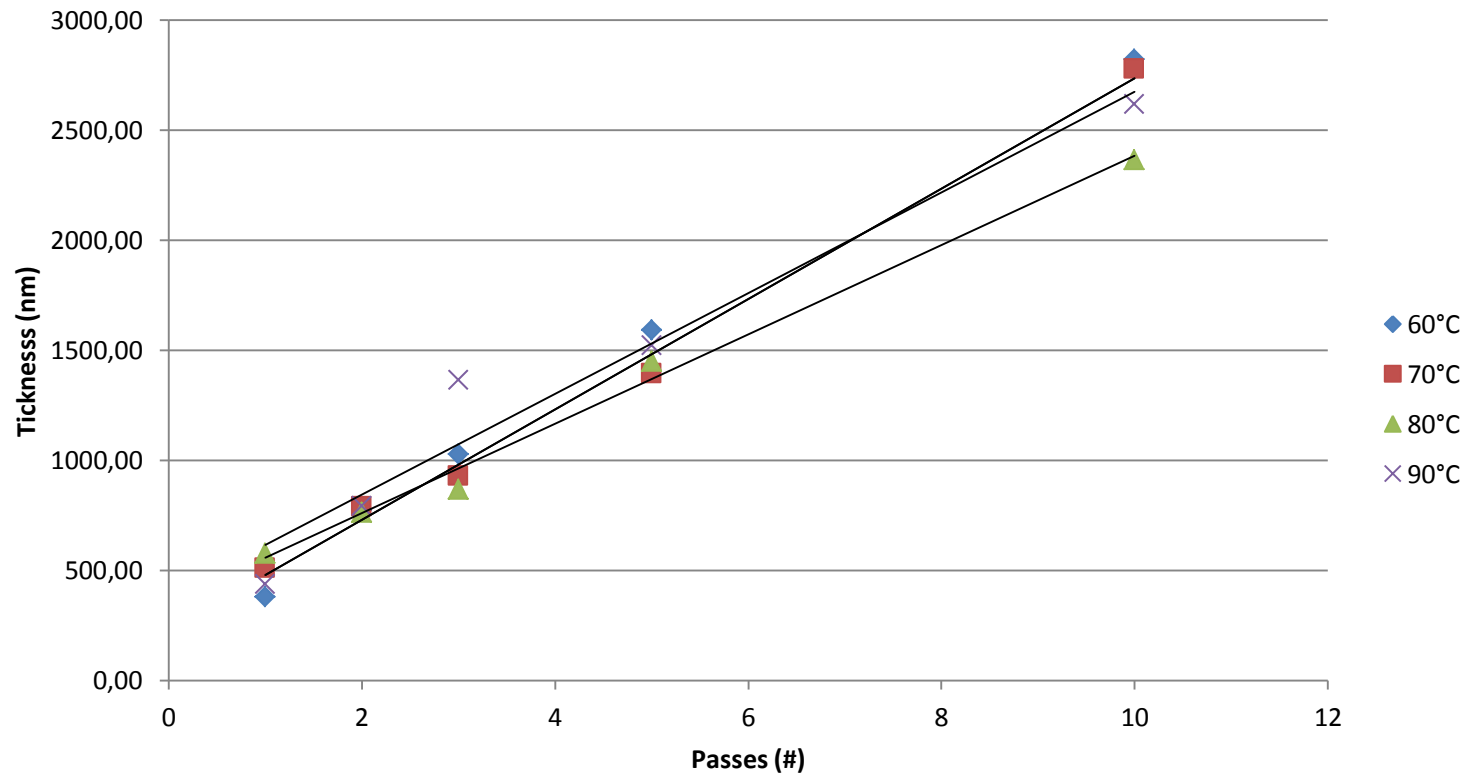
# THICKNESS – 30% ETHANOL

30% - 0.2ml/min



# THICKNESS – 70% ETHANOL

70% - 0.2ml/min





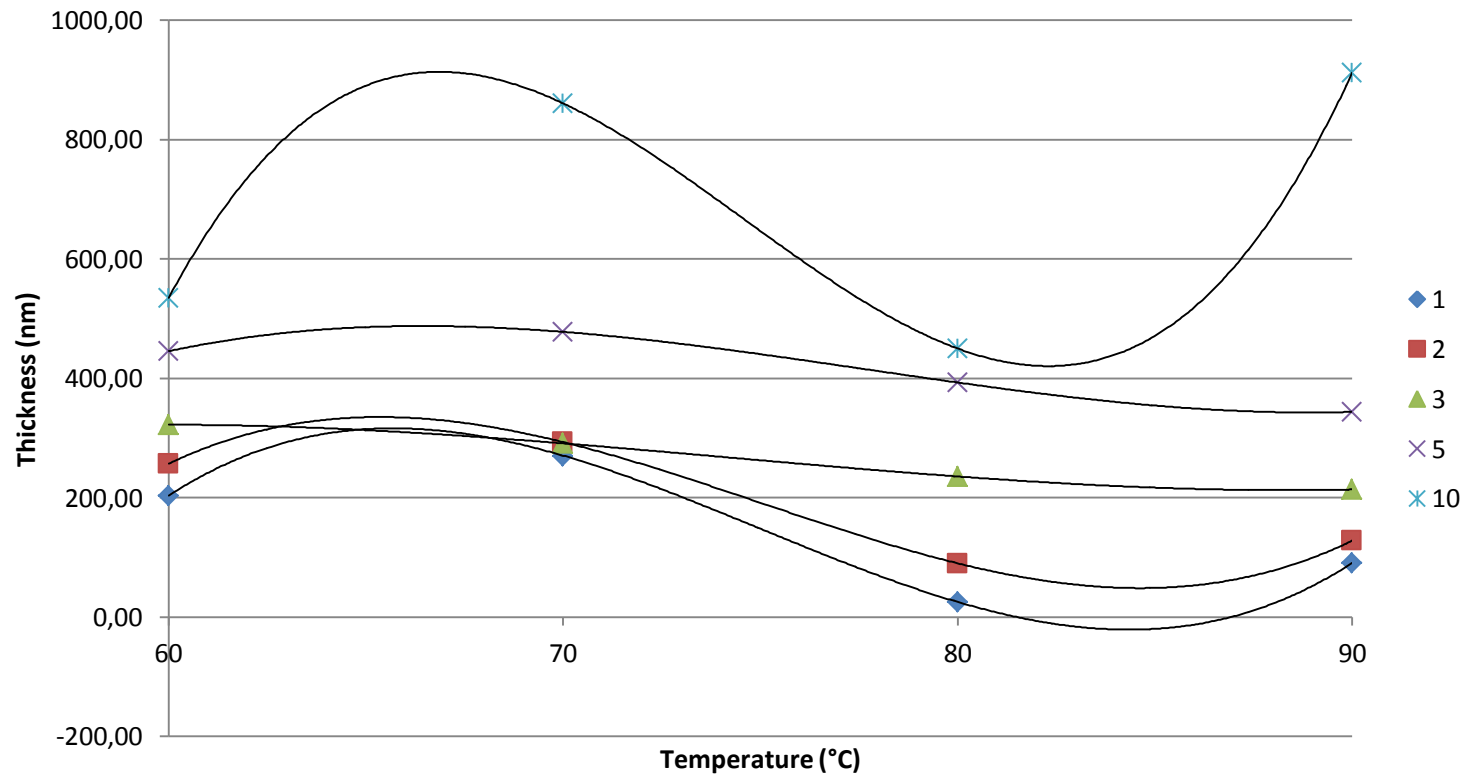
# THICKNESS

- 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.



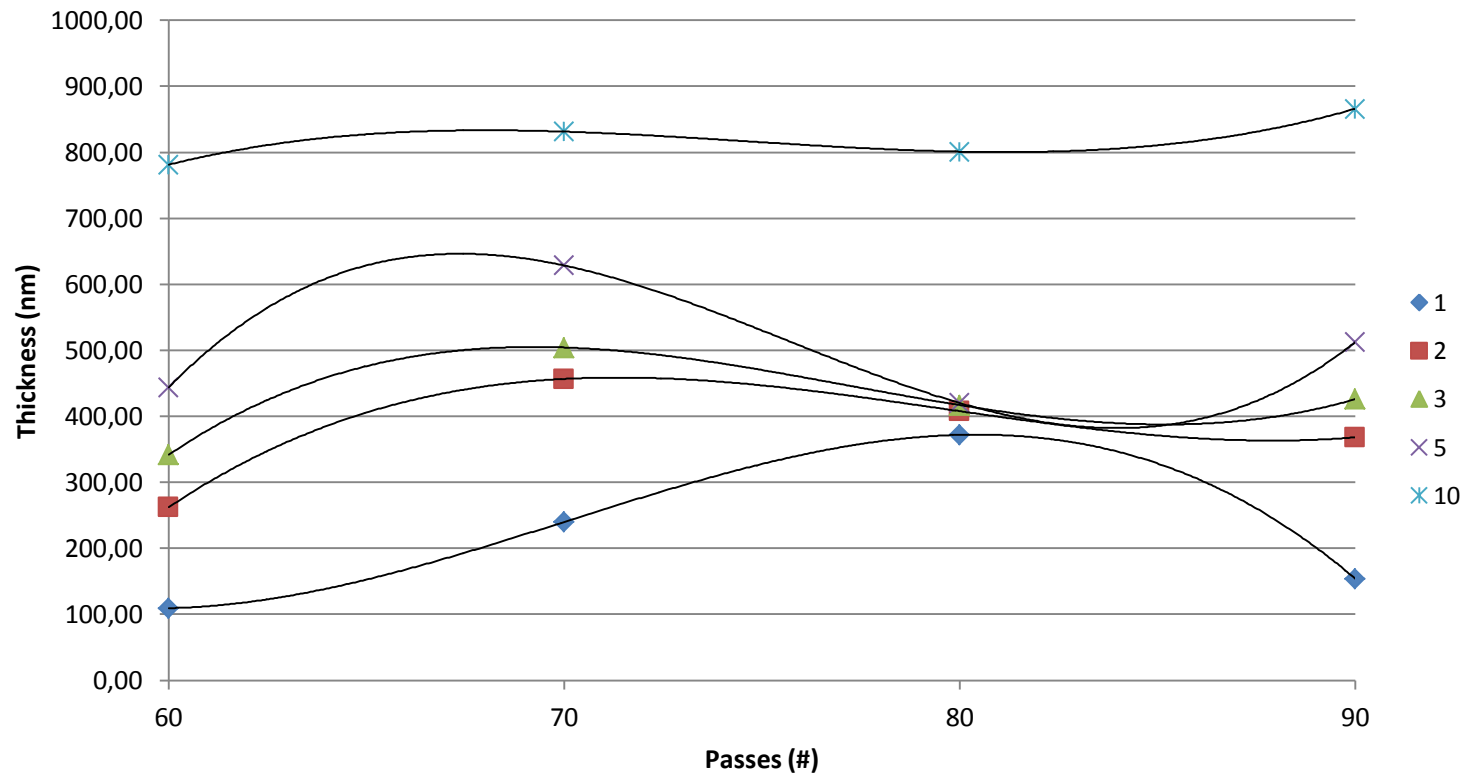
# THICKNESS – 30% ETHANOL

30% - 0.1 ml/min



# THICKNESS – 70% ETHANOL

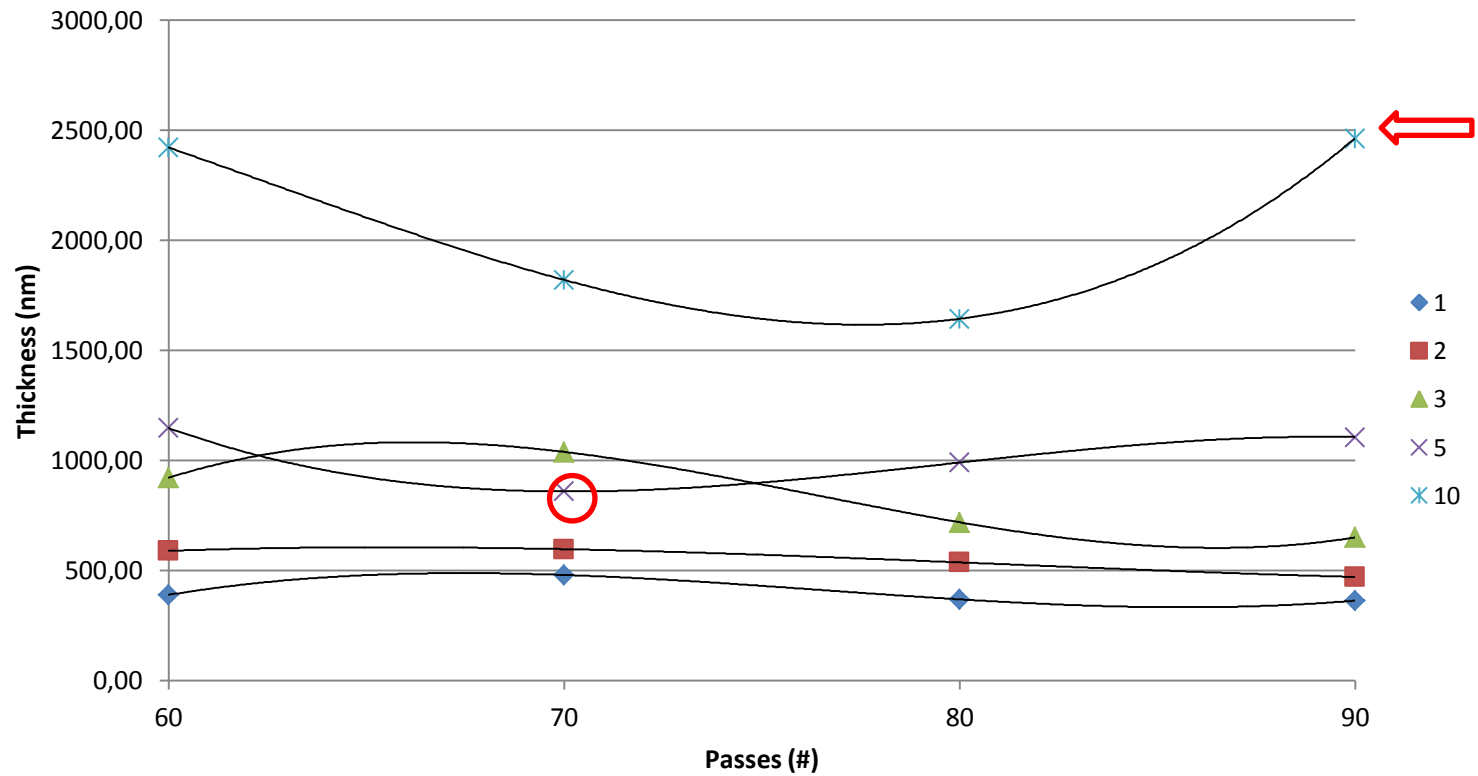
70% - 0.1 ml/min





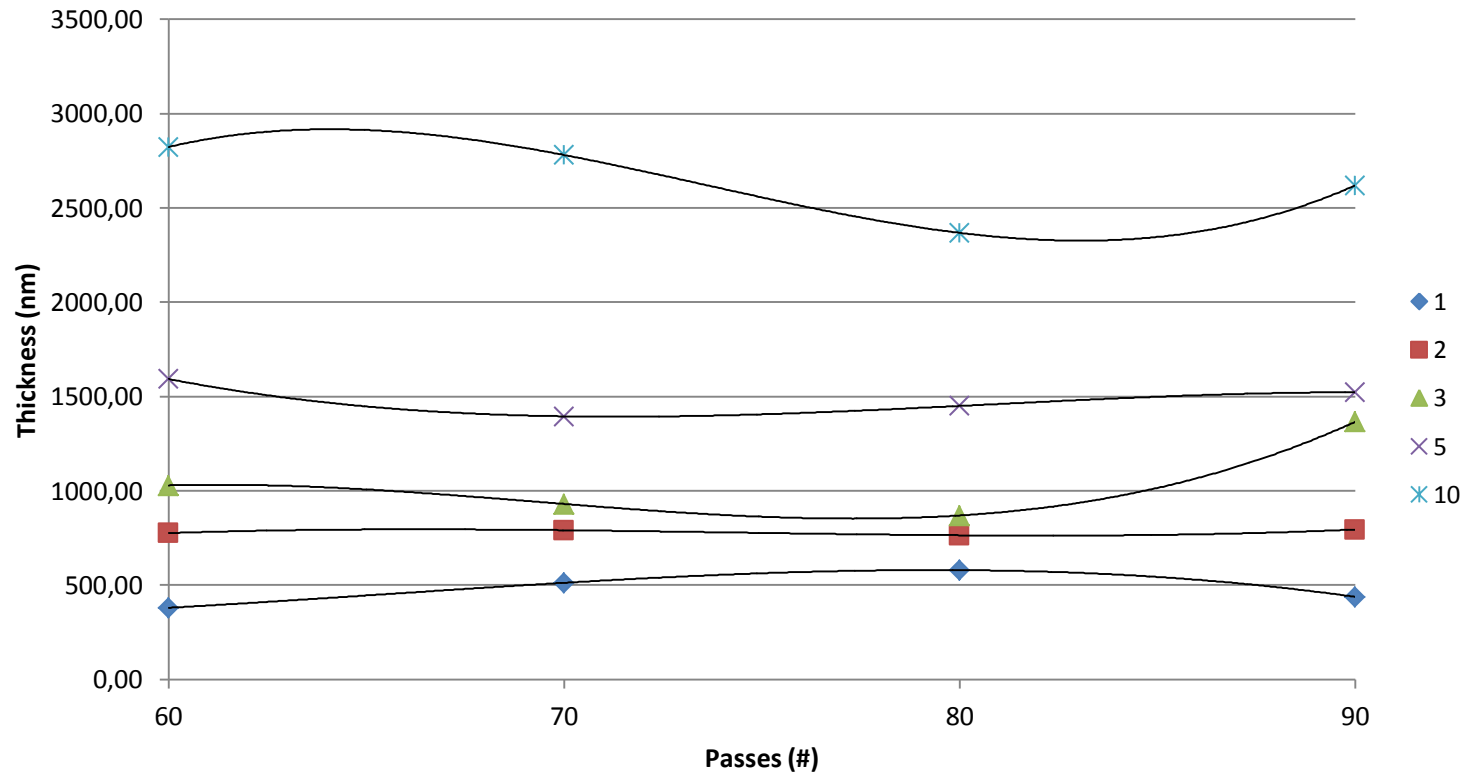
# THICKNESS – 30% ETHANOL

30% - 0.2 ml/min



# THICKNESS – 70% ETHANOL

70% - 0.2 ml/min



## 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!**