Progress report for project “Engineered surface platform for immobilization of microorganisms”. June – August 2021 (Month 34 – 36).

During this three-month period of the project data collation and overall data analysis activities were performed. Additionally, cell deposition for serial imaging and microbiological analysis was performed for the remaining platform groups (K-78, K-79, K-80). Imaging and microbiological analysis activities were performed as well. Based on the data analyzed so far, it was decided to prepare a scientific publication about cell attachment to UV-exposed and non-exposed glass samples. Some of the results were being prepared to be presented at four conferences. Additionally, a method for transferring surface micropatterns from the surfaces of immobilization platforms to the surfaces of other materials was developed.

The publication that was being prepared during this period and is still being worked on at this time concerns the patterns of cell attachment to glass surfaces based on the distribution of surface roughness and surface electrical potential. While not being about the developed immobilization platforms per se, it describes the relation between the two studied surface functionalization modalities and their interaction with yeast cells of different sizes. It is planned to publish the article until the end of this year.

While yet to be published, the results concerning cell attachment to the surfaces of immobilization platforms will be presented at three conferences. In fact, some of the results were already presented during the “ICY15 meets ICYGMB 30” conference which took place in Vienna, Austria on 23rd-27th of August. Two more presentations at international biotechnological conferences are planned – one at the “European Biotechnology Congress 2021” which will take place in Sofia, Bulgaria on 23rd-25th of September, and one at the “10th International Conference on Biomedical Engineering and Biotechnology” which will take place in China on the 15th-18th of November. Results of the development of the LiSt-KPFS technique for studying light-induced surface charge phenomena were also presented at the “Advanced Materials and Technologies 2022” conference-school hosted at Palanga, Lithuania on 23rd-27th of August. All of the conferences were or will be held online.

Lastly, to ensure the possibility of spin-off studies based on the results of the project it was decided to develop a method for transferring the microscale surface patterns from the amorphous silicon dioxide surfaces of the immobilization platforms onto other types of materials. At this point the team was interested in transferring the patterns onto the surfaces of thermoplastic polymer materials, therefore a two-step replication process based on hot microembossing was developed. In it the surface of interest is affixed onto the bottom a well-like holder which is filled up with a polyvinyl siloxane (PVS) slurry which is capable of penetrating into the microscale ridges present on the surface of an immobilization platform. The PVS slurry is cured until solidified and then removed from the well-like holder leaving the platform behind. Next, a thermoplastic material of interest (polycaprolactone (PCL) in this case) is heated up until its melting point in a custom-made crucible, after which the previously made PVS “stamp” is applied to the liquid polymer surface. After the PCL cools down and solidifies the “stamp” is removed and the resulting PCL surface is now patterned with the same microscale structures present on the surface of an immobilization platform. The results of the transfer can be seen in Figure 1, 2 and 3.

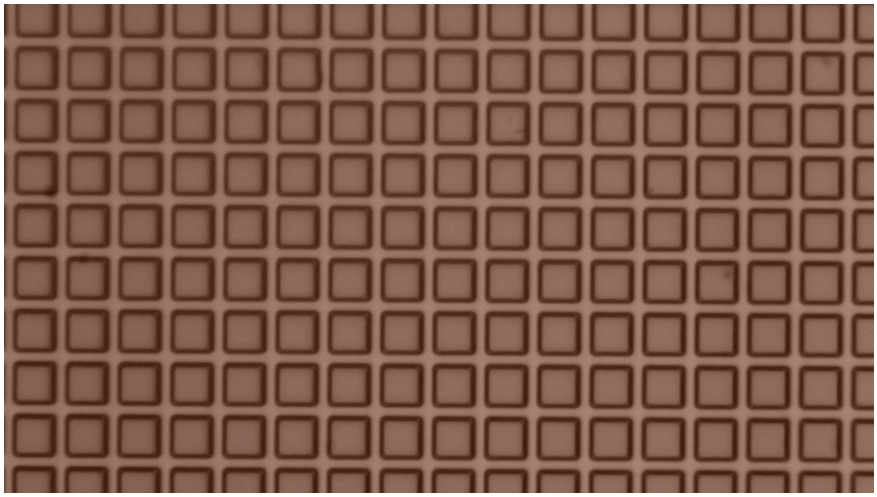

Figure 1. Surface microscale features of an immobilization platform from group 36-1-10 (200x magnification).

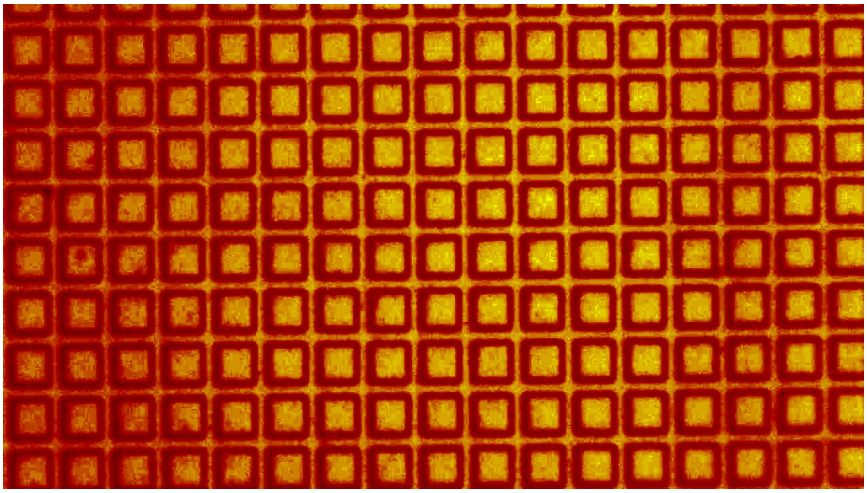

Figure 2. Microscale feature imprints on the surface of a PVS “stamp”.

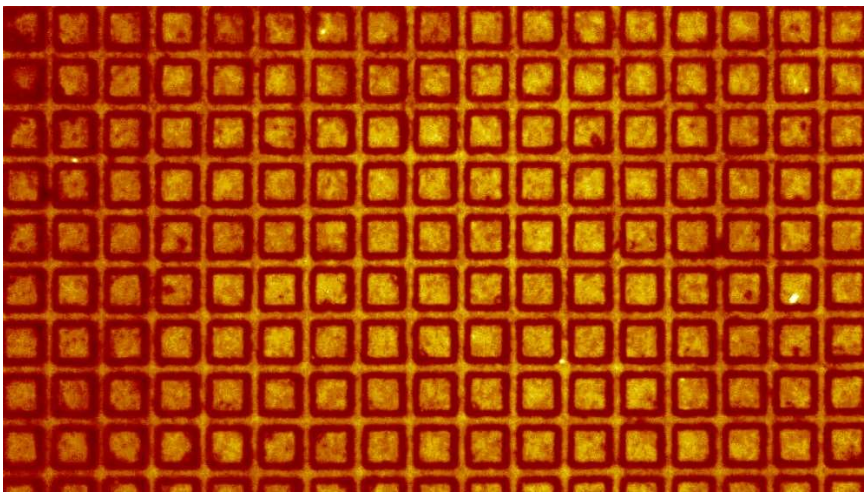

Figure 3. Surface microscale features transferred to the surface of a PCL substrate.

As can be seen, the shape and lateral dimensions of the microscale features can be reproduced using the described approach, however some improvement is still required. Additionally, if an additional replication step is added in which liquid PVS is applied to the already cured PVS surface, “negative”

structures (indents instead of pillars) can be applied to the surface of thermoplastic material the developed approach. The replication approach will be further developed outside of the scope of this project.