

2. Objective

Although many types of surface chemistries proved their practicability, the provision of an ideal surface is still an issue of current research, since almost all studies concentrate on the use of single surfaces for the generation of protein and antibody microarrays. Those surfaces are often derived from DNA microarray technology and a comparison between the studies is not possible due to different processing parameters. As a prerequisite for further developments, one objective of this study was the comparison of different surface chemistries for the production of both, protein and antibody microarrays. The evaluation should be conducted under conditions that allow direct comparison and should point towards a surface with superior characteristics, such as low detection limits and excellent signal-to-concentration ratio. The provision of such a surface chemistry would represent a significant optimisation of current protein microarray technology and would allow further optimisation of the protocols on a single surface.

Based on this surface optimisation, the second major focus was the development of protein microarray-based assay systems with novel functionalities. Up to today, no technology is available, which allows the multiplex screening of a multitude of different analytes on a single microarray. A solution to this problem should be capable of performing similar tasks as the commonly used ELISA, which is typically applied in the format of microtitre plates. The rationale behind this is to increase throughput and reduce the consumption of precious samples. Although many efforts have previously been made to transfer ELISA to the microchip format using conventional microarrays, microfluidic systems and chips bearing microwells, all current formats lack the possibility to screen several compounds simultaneously in a multiplex fashion without complicated liquid handling, surface modifications, or additional equipment.

The provision of a technique capable of multiplex analysis would also allow the use of microarray technology in new application areas, such as the highly-parallel screening of recombinant antibody fragments derived from phage display or the measurement of enzymatic activity on microarrays. Furthermore, the application of enzymes to this novel technology would allow a more sensitive detection, since, analogue to ELISA, a signal amplification by enzyme-secondary antibody conjugates would be possible.

As an alternative to microarray technology, this study also considered the application of nanowell arrays for the cell-free expression of proteins and enzymes. Such systems could then be used for the expression of large protein libraries and for the characterisation of inhibitors.