chemical etching of substrates, whereby the exposed areas of the substrate are attacked and dissolved by the chemical etch, while the unexposed monolayers areas protect the substrate from the etch.

Further details of the invention will become apparent from the following specific examples, which are intended to be merely illustrative and are not considered to limit the scope of the invention.

EXAMPLE 1

In a first example of the application of the process according to the invention, a SAM was first formed on a substrate comprising a 200 nm silver film sputter deposited on a polished silicon chip by immersing the substrate in an approximately 1 mM solution of mercaptoundecanoic acid in ethanol. Next, a 400 mesh electron microscopy grid was placed over the SAM on the substrate and the resulting assembly was irradiated for 1 hour with UV light from a mercury vapor lamp. The sample thereafter was immersed in an approximately 1 mM solution of octanethiol in ethanol, whereby the sulfonylundecanoic acid molecules which had formed in the exposed areas were exchanged for octanethiolate molecules. Subsequent analysis by SIMS imaging showed that a patterned image was formed in which features as small as 20 μm were easily recognizable.

EXAMPLE 2

A SAM of perfluorodecanethiol [$CF_3(CF_2)_7(CH_2)_2SH$] was formed on a gold substrate. The resulting thiolate monolayer was then exposed through a 300 mesh electron microscopy grid for one hour to UV light from a mercury vapor lamp, after which the exposed substrate was immersed for one hour in a 1 mM solution of mercaptoundecanoic acid [$HOOC(CH_2)_{10}SH$] in ethanol to obtain a patterned SAM comprised of squares of carboxydecanethiolate in a grid of perfluorodecanethiolate. The patterned SAM was immersed in a solution of the protein, avidin, and the avidin adsorbed to the areas of the SAM composed of the carboxy-terminated thiolate.

The molecular composition of the avidin patterned sample was then mapped by means of SIMS imaging. A SIMS image of the sample treated according to the process set forth above is shown in FIGS. **7***a* and **7***b*. The image of FIG. **7***a* is from CNO^- (mass **42**) which originates from the polypeptide backbone of the protein. The bright areas **50** represent regions where intense CNO^- signals are detected. These regions correspond to the locations where the mercaptoundecanoic acid has patterned into the perfluorinated decanethiol **2** monolayer. The image in FIG. **7***b* is from F^- (mass **19**) and was acquired from the same area as that of the CNO^- image. It demonstrates that perfluorinated thiol occupies regions where little avidin has adsorbed.

EXAMPLE 3

A SAM of decanethiol molecules on a silver-coated substrate is exposed to a desired pattern of ultraviolet light in an ambient air atmosphere to convert the thiolate groups in the exposed areas to sulfonate groups. The exposed monolayer is then immersed in a solution of a carboxylic acid-terminated alkylthiol compound so that a carboxylic acid terminated SAM is patterned into the exposed areas of the decanethiolate monolayer. A 9-mer DNA probe comprising a defined sequence of nine nucleotides is then covalently coupled to the carboxy-terminated regions. The substrate can then be exposed to a solution containing a DNA sample to be tested for the presence of a sequence complementary to the probe. If DNA having a complementary sequence is present, it will specifically bind to the probe areas of the substrate. This procedure is particularly useful to test for the presence of specific genetic defects.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example, and is not to be taken by way of limitation. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.

What is claimed is:

1. A process for creating a pattern comprising a two dimensional spacial distribution of thiolate compound molecules in a self-assembled monolayer formed on a substrate, said process comprising the steps of:

illuminating a surface of a self-assembled monolayer of a first thiolate compound in the presence of oxygen with high frequency electromagnetic radiation, distributed according to a desired pattern; and

immersing said substrate in a solution of a compound which forms a second thiolate compound, whereby molecules of said first thiolate compound in illuminated areas of said monolayer are exchanged for molecules of said second thiolate compound.

2. A process according to claim **1**, wherein said illuminating step is carried out in air.

3. A process according to claim **1**, wherein said step of illuminating comprises:

placing a mask over said surface of said self assembled monolayer, said mask having radiation transmitting and radiation blocking portions distributed according to said desired pattern, and;

projecting said radiation through said radiation transmitting portions onto the surface of the self-assembled monolayer.

4. A process according to claim **1**, wherein said step of illuminating comprises projecting said desired pattern of radiation onto the surface of the self-assembled monolayer through an optical focussing element.

5. A process according to claim **1**, wherein said step of illuminating comprises illuminating said surface of said self-assembled monolayer with light from a high pressure mercury vapor lamp.

6. A process according to claim **1**, wherein said substrate is selected from the group consisting of gold, silver, copper, platinum, iridium, palladium, rhodium, mercury, osmium, ruthenium, gallium arsenide, indium phosphide, and mercury cadmium telluride.

7. A process according to claim **1**, wherein said step of illuminating comprises illuminating said surface of said self-assembled monolayer with UV light or X-ray radiation.

8. A process for controlling chemical and physical properties of selected areas of a surface capable of forming a thiol self-assembled monolayer according to a predetermined pattern, said process comprising the steps of:

forming a self-assembled monolayer of a first thiolate compound on said surface;

exposing said self-assembled monolayer in the presence of oxygen to electromagnetic radiation distributed according to said predetermined pattern, said electromagnetic radiation selected from the group consisting of ultra violet and x-ray radiation; and

immersing the self-assembled monolayer in a solution of a compound which forms a second thiolate compound different from said first thiolate compound.