

end is approximately at the detection limit of mass spectrometry—a high-throughput protein profiling technique. The state-of-the-art for clinical protein measurements is still the ELISA assay. Yet ELISA is a low-throughput process, requiring a large amount of sample and long duration to complete a multiparameter plasma protein measurement. The high performance of the DEAL barcode chip, especially its increased sensitivity, is a key to realizing highly multiplexed measurements of a panel of proteins, including the low abundance cytokines, from small quantities of clinical blood samples.

[0232] Applicants therefore concluded that the DEAL barcode assay has a markedly high sensitivity, comparable to ELISA, leading to the feasibility of multiplexed detection of plasma proteins including low-abundance cell-cell signaling molecules, e.g. cytokines and chemokines, from a small quantity of sample.

Example 14

Assay Performed in a Barcoded Array

[0233] For the assays shown in the Examples 3-13 illustrated in the related figures, a DEAL immunoassay was used. To detect each protein, a pair of antibodies was chosen. One is conjugated to the secondary DNA strands that are complementary to the primary DNA strands flow-patterned on glass slides. This antibody also serves to capture proteins being detected, and then the biotin-labeled detection came in to bind to the same protein creating immunosandwich structure. Finally, Cy-3 or Cy5 labeled fluorescent streptavidin was used to visualize the results of bar-code through streptavidin-biotin binding.

[0234] Detection of human cytokine proteins prepared at different concentrations was first tested (FIG. 15). The results show the detection is highly specific, and exhibits increased sensitivity comparable to ELISA. Then, a multiparameter (up to 5 proteins) detection was demonstrated as in FIG. 16. TNF- α exhibits the best signal intensity due to the high affinity of the 10 anti-TNF- α AB. Having the high loading of primary DNA oligomers and by varying DNA concentrations in flow-patterning step, it is shown the a single bar-code can detect protein like hCG across a huge dynamic range, several orders of magnitude better than any conventional protein detection methods (FIG. 21). Finally, an integrated microfluidic device was fabricated, which comprises of a two-layer PDMS microfluidic chip bonded on to a bar-DEAL barcode glass chip, that allows rapid, sensitive detection of 13 different proteins at the same time out of 12 different human serum samples. The DEAL bar-code devices for the first time provide a highly multiplexed (as in protein microarray and mass spectrometry) method for protein detection at an ultra-high sensitivity as good as the state-of-art ELISA assay.

[0235] Barcoded array patterning is a generic technique that can be exploited to pattern DNA, protein, or even sera and tissue lysates. The inverse-phase bar-code array (serum or lysate array) can be used for high throughput drug screening and biomarker discovering.

Example 15

Manufacturing a Barcoded Array for Magnetic ID

[0236] A schematic representation of a method to manufacture a magnetic ID barcode on a small object such as a ring is shown in FIG. 31.

[0237] A PDMS microfluidic channels with a small exposed contact area can be manufactured using two-layer lithography (it means there are two layers of fluidic channels). The bottom layer can be contacted with the substrate e.g. the small-sized product and the fluid can be introduced from the upper layer that contains embedded fluidic channels to join the bottom layer channels at the small contact area to the large inlets at the sides of the PDMS device.

[0238] Once this PDMS device is attached onto the small subject, a number of distinct different molecules were flowed to the contact area to create a DNA barcoded array. Next, a library of complementary DNA-magnetic nanoparticle conjugates can be synthesized.

[0239] Therefore, the fabrication of magnetic barcode can be realized by simply immersing the small-sized subject patterned with DNA barcodes into a solution that contains several complementary DNA-magnetic nanoparticle conjugates. The different combination of complementary DNA-magnetic nanoparticle conjugates gives rise to a distinct magnetic ID barcode that can be readily read with a magnetoresistive scan head.

[0240] The examples set forth above are provided to give those of ordinary skill in the art a complete disclosure and description of how to make and use the embodiments of the devices, systems and methods of the disclosure, and are not intended to limit the scope of what the inventors regard as their disclosure. Modifications of the above-described modes for carrying out the disclosure that are obvious to persons of skill in the art are intended to be within the scope of the following claims. All patents and publications mentioned in the specification are indicative of the levels of skill of those skilled in the art to which the disclosure pertains. All references cited in this disclosure are incorporated by reference to the same extent as if each reference had been incorporated by reference in its entirety individually.

[0241] The entire disclosure of each document cited (including patents, patent applications, journal articles, abstracts, laboratory manuals, books, or other disclosures) in the Background, Detailed Description, and Examples is hereby incorporated herein by reference. Further, the hard copy of the sequence listing submitted herewith and the corresponding computer readable form are both incorporated herein by reference in their entireties.

[0242] It is to be understood that the disclosures are not limited to particular compositions or biological systems, which can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting. As used in this specification and the appended claims, the singular forms “a,” “an,” and “the” include plural referents unless the content clearly dictates otherwise. The term “plurality” includes two or more referents unless the content clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the disclosure pertains. Although any methods and materials similar or equivalent to those described herein can be used in the practice for testing of the specific examples of appropriate materials and methods are described herein.

[0243] A number of embodiments of the disclosure have been described. Nevertheless, it will be understood that various modifications may be made without departing from the