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(54) Title: SYSTEMS AND METHODS FOR PERFORMING MEASUREMENTS OF ONE OR MORE ANALYTES COMPRISING USING MAGNETIC PARTICLES AND APPLYING A MAGNETIC FIELD

(57) Abstract: Systems and methods for performing measurements of one or more materials are provided. One system is configured to transfer one or more materials to an imaging volume of a measurement device from one or more storage vessels. Another system is configured to image one or more materials in an imaging volume of a measurement device. An additional system is configured to substantially immobilize one or more materials in an imaging volume of a measurement device. A further system is configured to transfer one or more materials to an imaging volume of a measurement device from one or more storage vessels, to image the one or more materials in the imaging volume, to substantially immobilize the one or more materials in the imaging volume, or some combination thereof.

## AMENDED CLAIMS
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1. A method of performing a bioassay using a plurality of magnetically responsive particles in contact with one or more analytes forming a sample, comprising:

conveying the sample in a fluid stream to a reservoir;

loading the sample in the fluid stream into an imaging chamber to form an array of particles, substantially in a monolayer dispersed in an imaging plane;

immobilizing the array of particles in the imaging plane by application of a magnetic field to the array of particles in the imaging chamber;

illuminating the array of particles using a light source positioned at an acute angle to the imaging plane; and

collecting images from the illumination of the array of particles using a photosensitive detector positioned for collecting photons from the imaging plane.

2. The method of claim 1, wherein the light source comprises one or more LED's positioned circumferentially around and spaced from the array of particles.

3. The method of claim 1, wherein the photosensitive detector comprises one or more array detectors, selected from a group comprising one-dimensional (1D) and two-dimensional (2D) array detectors.

4. The method of claim 1, wherein the particles comprise a population of fluorescently labeled magnetically responsive beads.

5. The method of claim 4, wherein the population of fluorescently labeled magnetically responsive beads comprise two or more subsets of beads which, upon illumination, exhibit different fluorescent signals to identify the subsets of beads.

6. The method of claim 1, wherein the positions of the light source and the photosensitive detector relative to the array of particles optimizes brightness.

7. The method of claim 1, further comprising washing the immobilized particles prior to illumination.

8. A system for performing a bioassay where one or more analytes are exposed to a plurality of magnetically responsive particles to form a sample, comprising:

a sample container for holding the sample;

a reservoir for fluid conveyance of a portion of the sample from the container;

an imaging chamber configured for receiving said portion from the reservoir;

a magnet selectable for immobilizing said portion in a substantially monolayer array of particles within an imaging plane of the imaging chamber;

an illumination source positioned circumferentially and spaced from said array of particles; and

a photosensitive detector positioned for imaging the array of particles when illuminated.

9. The system of claim 8, wherein the illumination source comprises a plurality of LED's arranged in a ring on a collection side of the array of particles.

10. The system of claim 9, wherein the photosensitive detector is arranged substantially perpendicular to the plane of the array of particles and substantially central to the ring.

11. The system of claim 9, wherein the photosensitive detector is arranged substantially parallel to the plane of the array of particles.

12. The system of claim 9, wherein the illumination source and the photosensitive detector each comprise one or more lenses and filters.

13. The system of claim 8, further comprising a fluid chamber for washing the array of particles to remove unwanted fluorospheres prior to illumination.

14. The system of claim 8, wherein the imaging chamber comprises a plurality of recesses disposed to assist in holding the array of particles in the imaging chamber in a monolayer.

15. The system of claim 14, wherein the plurality of recesses comprise a pattern of recesses formed within, or proximate to, an internal surface of the imaging chamber.

16. The system of claim 15, wherein the pattern of recesses comprises a one-dimensional (1D) or two-dimensional (2D) pattern of recesses.

17. The system of claim 15, wherein the pattern of recesses comprises a pattern of square recesses.

18. The system of claim 15, wherein the pattern of recesses comprises a pattern of triangular recesses.

19. The system of claim 15, wherein the plurality of recesses are spaced away from the internal surface of the imaging chamber to allow fluid from a fluid chamber to wash the array of particles held within the recesses.

20. The system of claim 8, wherein the illumination source and the photosensitive detector are positioned on one side of the imaging chamber and the magnet is positioned on an opposite side of the imaging chamber.

21. The system of claim 20, wherein the magnet is positioned adjacent to the opposite side of the imaging chamber.

22. The system of claim 20, wherein the magnet is selectively spaced away from the opposite side of the imaging chamber.

23. The system of claim 20, further comprising one or more additional magnets positioned on the opposite side of the imaging chamber.