of wells. Arrangements of wells include those found in 96-well plates (12 x 8 array of wells), 384-well plates (24 x16 array of wells), and 1536-well plates (48 x 32 array of wells). ANSI/SLAS has published recommended microplate specifications. (See www.slas.org/SLAS/assets/File/ANSI_SLAS_1-2004_FootprintDimensions.pdf.)

[007] A variety of plate readers are available for conducting assay measurements in multi-well plates including readers that measure changes in optical absorbance, emission of luminescence (e.g., fluorescence, phosphorescence, chemiluminescence, and electrochemiluminescence), emission of radiation, changes in light scattering, and changes in a magnetic field. U.S. Patent Application Publication 2004/0022677 and U.S. Patent No. 7,842,246, respectively, of Wohlstadter et al. describe solutions that are useful for carrying out singleplex and multiplex ECL assays in a multi-well plate format. They include plates that comprise a plate top with through-holes that form the walls of the wells and a plate bottom that is sealed against the plate top to form the bottom of the wells. The plate bottom has patterned conductive layers that provide the wells with electrode surfaces that act as both solid phase supports for binding reactions as well as electrodes for inducing electrochemiluminescence (ECL). The conductive layers may also include electrical contacts for applying electrical energy to the electrode surfaces.

[008] Despite such known methods and systems for conducting assays, improved apparatuses, systems, methods, reagents, and kits for conducting automated sampling, sample preparation, and/or sample analysis in a multi-well plate assay format are needed.

[009] Additionally, plate reading systems such as CCD (charge coupled device) camera systems are conventionally used for measuring properties of analytes in a multi-well assay plate. Conventional CCD camera systems may suffer from excessive crosstalk between analyte measurements. The measurement of one analyte may affect the measurement of another, subsequently measured analyte. Apparatuses, systems, and methods described herein may reduce or eliminate the amount of crosstalk in a CCD camera system for measuring analytes in multi-well assay plates.

SUMMARY OF THE INVENTION

[0010] According to a first aspect of the present invention, there is provided a system configured to measure a plurality of analytes in an assay plate with reduced crosstalk between analytes. The system includes a CCD camera including a CCD, an analog front end circuit, and an analog to digital

circuit, the CCD camera being configured to measure the plurality of analytes and coupled to a focusing system and a plate carriage system configured to locate the assay plate to facilitate measurement of the plurality of analytes. The analog front end circuit is configured to receive a readout signal from a serial register of the CCD and to transfer the readout signal to the analog to digital circuit to generate a plurality of image data points, the analog front end circuit includes a reference level clamp circuit configured with a time constant selected to fully reset a reference level between sequential image data point readings so as to reduce crosstalk between a first measurement of a first one of the plurality of analytes and a second measurement of a second one of the plurality of analytes.

[0011] According to a second aspect of the present invention, there is provided a method of reducing crosstalk between measurements of a plurality of analytes in an assay plate performed by a CCD camera. The method comprises measuring the plurality of analytes with the CCD camera, the CCD camera including a CCD, an analog front end circuit, and an analog to digital circuit and being coupled to a focusing system and a plate carriage system configured to locate the assay plate to facilitate measurement of the plurality of analytes; receiving, via the analog front end circuit, a readout signal from the serial register of the CCD. Receiving the readout signal includes: transferring the readout signal from the serial register to the analog to digital circuit to generate a first image data point, resetting fully, via a reference level clamp circuit having a time constant, a reference level of the analog front end circuit, transferring the readout signal from the serial register to the analog to digital circuit to generate a second image data point, wherein the time constant is selected so as to reduce crosstalk between a first measurement of a first one of the plurality of analytes and a second measurement of a second one of the plurality of analytes.

[0012] The present invention is directed to an instrument comprising

a contact platform, wherein the contact platform comprises at least a pair of electrical contact probes, wherein the at least a pair of electrical contact probes comprise upstanding, spring-loaded pins;

a controller operatively connected to a voltage source to conduct a voltage to the at least a pair of electrical contact probes,

a plate carriage frame adapted to transport a single-well addressable multi-well plate and to position the multi-well plate relative to the contact platform, such that the voltage can be applied to one or more wells on the plate,

WE CLAIM:

1. A system configured to measure a plurality of analytes in an assay plate with reduced crosstalk between analytes, the system including:

a CCD camera including a CCD, an analog front end circuit, and an analog to digital circuit, the CCD camera being configured to measure the plurality of analytes and coupled to a focusing system and a plate carriage system configured to locate the assay plate to facilitate measurement of the plurality of analytes,

wherein the analog front end circuit is configured to receive a readout signal from a serial register of the CCD and to transfer the readout signal to the analog to digital circuit to generate a plurality of image data points, the analog front end circuit includes a reference level clamp circuit configured with a time constant selected to fully reset a reference level between sequential image data point readings so as to reduce crosstalk between a first measurement of a first one of the plurality of analytes and a second measurement of a second one of the plurality of analytes.

2. The system of claim 1, wherein the first one of the plurality of analytes and the second one of the plurality of analytes are contained in a single well of the assay plate.

3. The system of claim 1, wherein the first one of the plurality of analytes and the second one of the plurality of analytes are contained in different wells of the assay plate.

4. The system of claim 1, wherein fully resetting the reference level between sequential image data point readings causes the amplitude of the reference level to return to a predetermined value between sequential image data point readings.

5. The system of claim 1, wherein fully resetting the reference level between sequential image data point readings reduces an effect of a first image data point value on a second image data point value obtained sequentially after the first image data point value.

6. The system of claim 1, wherein the time constant is a decay time constant of the reference level clamp circuit.

7. The system of claim 1, wherein each of the plurality of image data points is representative of a pixel of the CCD.

8. The system of claim 1, wherein each of the plurality of image data points is representative of a plurality of binned pixels of the CCD.

9. The system of claim 1, wherein the plurality of analytes are spatially separated from one another.

10. A method of reducing crosstalk between measurements of a plurality of analytes in an assay plate performed by a CCD camera, the method comprising:

measuring the plurality of analytes with the CCD camera, the CCD camera including a CCD, an analog front end circuit, and an analog to digital circuit and being coupled to a focusing system and a plate carriage system configured to locate the assay plate to facilitate measurement of the plurality of analytes;

receiving, via the analog front end circuit, a readout signal from the serial register of the CCD, wherein receiving the readout signal includes:

transferring the readout signal from the serial register to the analog to digital circuit to generate a first image data point,

resetting fully, via a reference level clamp circuit having a time constant, a reference level of the analog front end circuit,

transferring the readout signal from the serial register to the analog to digital circuit to generate a second image data point,

wherein the time constant is selected so as to reduce crosstalk between a first measurement of a first one of the plurality of analytes and a second measurement of a second one of the plurality of analytes.

11. The method of claim 10, wherein the first one of the plurality of analytes and the second one of the plurality of analytes are contained in a single well of the assay plate.

12. The method of claim 10, wherein the first one of the plurality of analytes and the second one of the plurality of analytes are contained in different wells of the assay plate.

13. The method of claim 10, wherein resetting the reference level of the analog front end circuit between sequential image data point readings includes returning the amplitude of the reference level to return to a predetermined value between sequential image data point readings.

14. The method of claim 10, wherein resetting the reference level between sequential image data point readings reduces an effect of a first image data point value on a second image data point value obtained sequentially after the first image data point value.

15. The method of claim 10, wherein the time constant is a decay time constant of the reference level clamp circuit.

16. The method of claim 10, wherein each of the plurality of image data points is representative of a pixel of the CCD.

17. The method of claim 10, wherein each of the plurality of image data points is representative of a plurality of binned pixels of the CCD.

18. The method of claim 10, wherein the plurality of analytes are spatially separated from one another.