[008] Multi-well assay plates (also known as microtiter plates or microplates) have become a standard format for processing and analysis of multiple samples. Multi-well assay plates can take a variety of forms, sizes, and shapes. For convenience, some standards have appeared for instrumentation used to process samples for high-throughput assays. Multi-well assay plates typically are made in standard sizes and shapes and have standard arrangements 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.) See ANSI SLAS 1-2004 (R2012): Footprint Dimensions (*last up-dated January 9, 2004*); ANSI SLAS 2-2004 (R2012): Height Dimensions (*last updated January 9, 2004*); ANSI SLAS 3-2004 (R2012): Bottom Outside Flange Dimensions (*last updated January 9, 2004*); ANSI SLAS 4-2004 (R2012): Well Positions (*last updated January 9, 2004*); and ANSI SLAS 6-2012: Well Bottom Elevation (*last updated April 09, 2009.)*

[009] 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.

[0010] 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.

SUMMARY OF THE INVENTION

[0011] Embodiments of ~~T~~the present invention include~~s~~, but ~~is~~ are not limited to, any and all combinations and sub-combinations of technical features disclosed herein with respect to the electrochemiluminescent (ECL) readers described here.

[0012] According to an aspect of ~~T~~the present invention, there is provided~~also related to~~ an instrument that comprises a light detection system having a CCD sensor and an optical lens system. The light detection system is positioned above a single

well at a time in a multi-well plate to conduct an electrochemiluminescence analysis of said single well. The area of the CCD sensor is approximately 1x to 2x of an~~substantially the same as the~~ area of said single well. The light detection system further comprises a cooling device sized and dimensioned to cool the CCD sensor. A heat removal system comprising at least one fan oriented at an angle is provided to pull a heated air exhausted from said cooling device into a flow plenum and out of the instrument.

[0013] The optical lens system may comprise a plurality of lenses and the plurality of lenses have both spherical and aspherical surfaces. The area of the plurality of lenses is larger than the area of said single well, and larger than the area of the CCD sensor. The lenses can be made from a hard polymeric material and a non-crystalline, amorphous transparent material such as glass.

[0014] The light detection system may be mounted in a substantially vertical direction onto a housing top, and the heat removal system is also mounted onto the housing top.

[0015] The at least one fan may be housed within the flow plenum, and the flow plenum further houses at least one printed circuit board (PCB) and comprises at least one opening to allow electrical connections between the at least one PCB and electrical components outside of the plenum. A flow baffle may be positioned within the plenum to minimize recirculation of air within the instrument. The heated air may flow away from the camera and plate across the at least one PCB before exiting the instrument.

[0016] Also provided is an instrument comprising a contact platform, wherein the contact platform comprises at least a pair of electrical contact probes, which may be 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, and a vertical lift system. The vertical lift system may move the contact platform to contact corresponding electrode contacts located on a bottom of said multi-well plate. The vertical lift system may include a worm gear mating with a geared portion of a leadscrew, such that a rotation of the worm gear rotates the leadscrew. The leadscrew is threadedly attached to a support base that supports the contact platform, such that a rotation of the leadscrew lifts or lowers the support base and the contact platform.

[0017] A motor may be adapted to rotate the worm gear, and the motor is controlled by the controller. The vertical lift system may comprise a guide shaft sized and dimensioned to slide within a corresponding hole in the support base to allow the support base to slide along the guide shaft. The worm gear may be oriented in a substantially horizontal direction and the leadscrew is oriented in a substantially vertical direction.

BRIEF DESCRIPTION OF DRAWINGS