ArcDia's Two-Photon Fluorescence Excitation Technology in COVID-19 Diagnostic Use

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ArcDia International Ltd. addresses healthcare's largest problems with its rapid infectious diagnostics platform, the mariPOC®. The company has about 35 employees representing various fields of science and technology. The mariPOC® is IVD CE marked point-of-care test system for respiratory tract infections, pharyngitis and gastrointestinal infection diagnostics in twenty minutes. ArcDia's mariAST™ platform is designed to tackle the growing problem of antibiotic resistance by enabling antimicrobial susceptibility testing in hours instead of days.

ArcDia's proprietary detection technology, called the TPX-technology, is based on two-photon excitation and detection of fluorescence. A compact diode-pumped solid-state Nd:YAG laser with sub-ns pulses is used as an excitation source. The focused laser beam is directed into the microtiter plate containing the patient sample diluted in proprietary buffer, microparticles coated with antibodies specific for the target biomolecule (e.g. SARS-CoV-2 protein) of interest, and fluorescently labeled secondary antibodies. The fluorescent molecule complexes concentrate on the surface of microparticles in proportion to the target concentration in the sample. Individual microparticles are then pulled by optical forces through the focus [Fig 1]. The presence of a particle in the focus is detected using a confocal arrangement for back-scattered excitation light. When a particle is in focus, the obtained fluorescence signal is proportional to the target molecule concentration. Otherwise, the "background" fluorescence and scattering signals provide information about the sample material.

By combining information from both the fluorescence signal and the back-scattered excitation light signal, it is possible to verify automatically the technical reliability of the sample measurement and analysis process. A deviating profile of measured parameters indicates a problem (e.g. an air bubble) in the sample. Only those analyses that meet the acceptance criteria are reported to the user for clinical decision making.

As a summary, the TPX system takes full advantage of its illumination source:

1. The intensity of the laser pulses is high enough for two-photon excitation in the focus.
2. Optical forces guide the particles through the focus.
3. Both particle data and background data are important: they are taken into account in compensation and verification of results.
4. The detected signals originate from the focus, allowing good sensitivity. Therefore simple and robust sample preprocessing can be used.

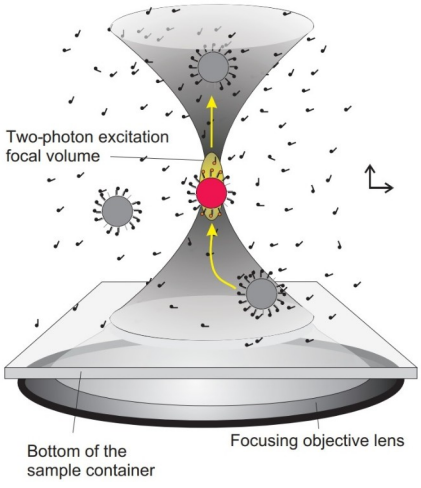

Fig 1: Microparticle going through the focal point due to the optical forces.

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2. Koskinen, Janne O. Two-photon excitation fluorometry in detection of infectious diseases. University of Turku, Finland. Annales Universitatis Turkuensis, 2008, Ser. A1, 384.