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**Siskiyou Solves Thermal Issues Associated with Flow Cytometry Miniaturization**

GRANTS PASS, Ore., Aug. 17, 2015 — Although product miniaturization can confer numerous practical advantages, it may create significant design issues — hurdles that need to be overcome to make the miniaturization a reality. Siskiyou Corp., a supplier of positioning equipment for life sciences and which specializes in building hardware for space- and access-restricted applications, has just solved such an obstacle. The company has rectified thermal management issues associated with the miniaturization of flow cytometers.

A cytometer manufacturer recently had attempted to miniaturize such a system, the impetus for which was fueled by the desire to reduce the length, complexity and cost of beam setup, thus improving instrument stability and reliability. The desired miniaturization also aimed to allow for such a system's laser excitation modules to be placed in closer proximity to the flow cell.

Flow cytometers have inherent trade-offs between speed and sensitivity. Higher sensitivity is achieved by restricting the diameter of the core stream to just a few microns through a process called hydrodynamic focusing. The excitation laser beam is then focused down to a similar diameter, resulting in a very bright (i.e., strong) signal from each cell. However, a narrower core stream reduces the rate at which the sample passes through the flow cell.

For example, this slower speed can be particularly problematic when counting very rare blood cells. This makes it critical that this higher-sensitivity configuration involves no further performance trade-offs or compromises. Furthermore, since micron shifts in a focused beam position affect overall detection efficiency, proper laser alignment is more critical in a narrow core system.

This typically makes these high-sensitivity setups less robust than conventional instruments with wider streams, thus necessitating a higher level of maintenance. In fact, optical misalignment is a leading cause of performance degradation in these instruments and is a common reason for field service. By physically placing the laser or lasers closer to the interaction zone, the optical throw distance is reduced, thus creating a more stable and reliable final product.

The cytometer manufacturer contracted Diode Laser Concepts Inc. (DLC) of Medford, Ore., a supplier of custom OEM laser-diode-based solutions, to design a new red (640 nm) laser engine for its miniaturized cytometer. DLC then turned to Siskiyou to create the adjustable mounting hardware.

This application required a mounting arrangement that would allow for 3D, linear (XYZ) adjustment of the focused laser spot. Key design choices were selecting a stage material and bearing type that would achieve the necessary adjustment range and resolution, as well as to provide lockable, long-term mechanical stability while meeting the overall package size and cost constraints.

In this case, 20-mm travel cross roller bearing aluminum stages with 100-tpi adjustability were chosen, since these standard Siskiyou-manufactured products deliver the requisite performance in the most cost-effective format.

Thermal management, however, turned out to be a major challenge. The laser diode is thermoelectrically cooled (TEC) to maintain constant output characteristics, such as beam pointing, beam shape and wavelength. The heat removed by the TEC method must be efficiently coupled through the metal stages to the base platform, which acts as the final heat sink. While better heat flow enables the instrument to more rapidly achieve thermomechanical stability at the submicron level, this thermal management should not unduly impact cost or complexity.

After several iterations, Siskiyou found a solution based on connecting the three stages via customized, thin aluminum plates. Testing at DLC showed that this approach achieved submicron-level repeatability and stability at the flow cell, with a warm-up time of less than 1 minute. For perspective, it is not uncommon for large-frame flow cytometers to require a 30-minute warm-up time for the laser and beam delivery setup, which has a significant negative impact on measurement costs and laser lifetime.

Now approved by the flow cytometer manufacturer, this new subsystem is now incorporated in the company's next generation instrument.

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