Recent advances in nanotechnology research and manufacturing have increased the importance of vibration control for optoelectronics research and industry. Fortunately, vibration-control technology has kept pace with the stringent requirements of the submicron realm, and a variety of equipment is available to minimize most vibration frequencies. In particular, the proper optical table design can alleviate many vibration-induced headaches.

Rigidity and damping are two primary considerations when choosing an optical table design. The tabletop itself is characterized in terms of rigidity, while its supports are characterized in terms of their vibration-isolating properties. We can quantify tabletop rigidity in terms of static and dynamic rigidity. Static rigidity describes the ability of the table to resist deflection under an applied load; the higher the rigidity, the less the table deflects. Dynamic rigidity defines the table performance in response to external forces such as floor vibration, acoustic noise, and/or mechanical sources on the work surface.

The most effective way to minimize vibrational effects is to choose a tabletop with internal tuned-spring mass vibration dampers built into the table structure. Optical tables designed with vibration-damping technology reduce the amplitude of the table's natural resonance peaks. Damping also eliminates ringing caused by impacts from dropped tools or periodic excitation from rotating machinery by absorbing the created energy.

We can classify damping as broadband and tuned. Broadband damping, as the name implies, provides some damping over a wide range of frequencies. Tuned damping, on the other hand, provides much higher levels of damping at selectively tuned frequencies. Tuned mass dampers selectively phase cancel the first several natural bending modes of the table structure. This technique effectively splits the single high-amplitude peaks to two low-amplitude peaks, making tuned damping more effective for reducing table vibrations (see figure).

The most common optical table supports incorporate regulated pneumatic vibration isolators. Essentially mechanical low-pass filter systems, pneumatic isolators exhibit very low natural frequencies (between 1 and 2 Hz). Most pneumatic isolators operate effectively above several hertz, but at their natural frequency they actually provide some amplification. Tuned vibration damping will reduce the amplification at the natural frequency and prevent the system from oscillating in response to transient vibrations.

A primary advantage of pneumatic isolators is that they offer a very low spring constant compared with their small range of travel. With pneumatic isolation supports, a table can self-level when loads are moved across the work surface.

The choice of optical table depends upon the resolution requirements of your application, the amount of mass to be supported, and the ambient noise in your work environment. To determine the table best suited for your application, consider your requirements for performance, size, and thickness.

High-resolution applications such as holography, ultrafast research, nanopositioning, and imaging above 10,000X require highly rigid tables with tuned damping technology and vibration-isolation support systems; acoustic enclosures and soft mounts for machinery further decrease acoustic noise and floor vibrations. Applications such as bio-imaging, Raman spectroscopy, and micromachining may only require broadband damping and rigid supports. Careful attention should be paid to the ambient noise in the work environment.

Tables typically range in size from 4 ft. x 6 ft. to 5 ft. x 20 ft., and can be built to any shape desired. Generally, thicker tables provide greater stiffness and have a higher natural (resonant) frequency. A thicker table will deflect less and the higher resonant frequency provided will minimize the relative motion between components on the table.

Wide ranges of optical table options are available to suit every optoelectronic application. The important issues to consider when choosing an optical table are the resolution demands of your application, the amount of equipment you expect to use, and the ambient noise in the work environment.

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