# Micromachining of Carbon Nanocomposites with Nd:YAG and Nd:$YVO_4$ Frequency Converted Solid State Lasers

Larry Dosser*, Ken Hix*, Kevin Hartke*, Rich Vaia**, Mingwei Li***

* Mound Laser & Photonics Center, Inc., 720 Mound Ave., Miamisburg, OH 45342;
** Air-Force Research Laboratory, Wright Patterson Air Force Base, OH 45433;
*** Spectra-Physics, Inc., 1335 Terra Bella Ave., Mountain View, CA 94043

Abstract

Carbon nanocomposites consist of thermoset and thermoplastic materials filled with carbon nano-particles (nanotubes, bucky balls, etc.). This new and innovative group of materials offers many advantages over standard polymers such as electrical/thermal conductivity and improved structural properties. In the current study, Nd:YAG and Nd:$YVO_4$ solid-state lasers were used to micromachine carbon nanocomposite thermoplastic materials. Experimentation was completed to compare the ability to laser micromachine carbon nanomaterial, carbon black, and unfilled polyurethane. The experimentation studied the relationship between repetition rate, travel speed, and material removal rate. The processing consisted of cutting channels into the materials using an Nd:$YVO_4$ laser at 1064, 532, and 355 nm wavelengths. The material removal rate and groove width were quantified for all wavelengths and compared versus the experimental variables. Trials were also completed on laser machining deep channels using an Nd:YAG laser and polyetheretherketone (PEEK) filled with carbon black and carbon nanofiber. The results of the experimentation show similar material removal rates for carbon black and carbon nanofiber filled polyurethane. The PEEK material exhibited high aspect ratio channels with both carbon black and carbon nanofiber fillers. Laser micromachining of polymers which were previously unmachinable using infra-red wavelengths has been demonstrated.

***For the complete technical paper:***
Email: sales@mlpc.com
Please include your name, company, title, and phone number.