CHARACTERIZATION OF PARTICLES GENERATED DURING THE LASER ABLATION SURFACE CLEANING

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Laser ablation is defined as the removal of material by laser irradiation. A recent application of laser ablation is surface decontamination and cleaning (Pleasants et al., 2004; Li, 2002). During the laser decontamination and/or cleaning processes, a large number of particles are produced ranging in size from nanometers to micrometers. When inhaled, these particles can cause adverse health effect. Productions of particles are also critical in determining the surface cleaning efficiency of the laser ablation process. Using a scanning mobility particle sizer (SMPS) system and an aerosol particle sizer (APS), particles generated by laser ablation from the surfaces of cement, chromium-embedded cement, and alumina were experimentally investigated.

Nd:YAG laser pulses having 3-5 ns of pulse width (the full width half maximum) were irradiated on the surfaces of rotating sample targets at a repetition rate of 10 Hz with at 1064, 532, or 266-nm of wavelengths. Among the three wavelengths, the 266-nm laser was most efficient in generating particles from the surfaces (Lee and Cheng, 2004). In the 266-nm laser ablation study, cement was found to be the most effective for particle removal, alumina the next, and stainless steel the least among the three materials tested, and chromium (dopped in cement) showed almost no effects on particle production. Generated particles showed bimodal size distributions; a smaller mode peaked at about 50-70 nm was detected by SMPS, and a larger mode (peaked at about 0.70-0.85 μm) by APS. Based on transmission electron microscope (TEM) analyses, the particles in the smaller mode and larger modes were likely produced by different mechanisms. Results will be presented, and possible hypotheses for the particle generation mechanisms will be discussed.

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