Laser Generated Airborne Particles during Surface Decontamination

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Laser removal of materials from a surface was investigated as a novel means of decontamination for nuclear facilities where heavy metals and radionuclides are present. This decontamination is rapid, simple, and dry that does not produce a large volume of contaminated wastewater and mixed waste current methods do. The removed materials by laser decontamination were converted into particulate matter that can be removed easily by filtration. We employed a fourth-harmonic generated wavelength (i.e., 266-nm) from an Nd: YAG laser as the energy source for surface decontamination. Particles generated by 266-nm laser ablation from cement, chromium-embedded cement, stainless steel, and alumina surfaces were experimentally investigated. All materials tested except stainless steel produce particles following a bimodal size distribution. A smaller mode was found to peak between 40 and 70 nm as observed by a mobility analyzer, and a larger mode (peaked between 0.6 and 1.0 micrometer) was observed by a time-of-flight aerodynamic particle sizer. The observed geometric mean diameters of particles appear to be independent of the applied laser fluence. Analysis by using **t**ransmission **e**lectron **mi**croscope (TEM) shows particle aggregates consisting of smaller primary particles. Different mechanism was proposed for formation of micrometer size particles from that of the aggregates that consist of nanometer primary particles. Figure 1 shows the TEM micrograph of chain aggregates that consist of nanometer-size primary particles with diameters less than 10 nm by TEM. This result indicates that particles in the smaller mode detected by mobility analysis were likely to be the aggregates. Electron micrograph of micrometer-size particles are displayed in Figure 2. The general shape of these micrometer particles are spherical indicating that solidification of materials ejected directly by laser spallation from molten surface was a possibility for the formation of the spherical micrometer particles.

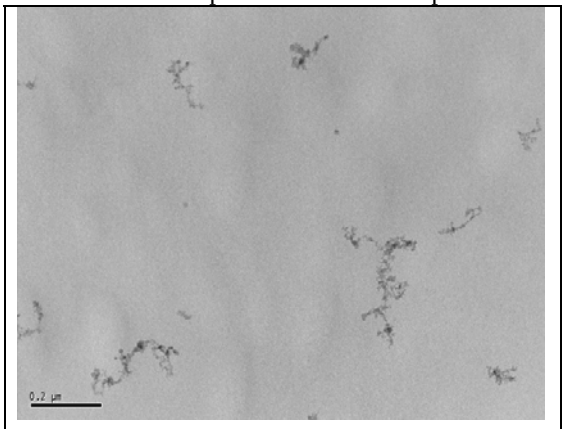

Figure 1. TEM micrograph shows aggregates of nanometer particles

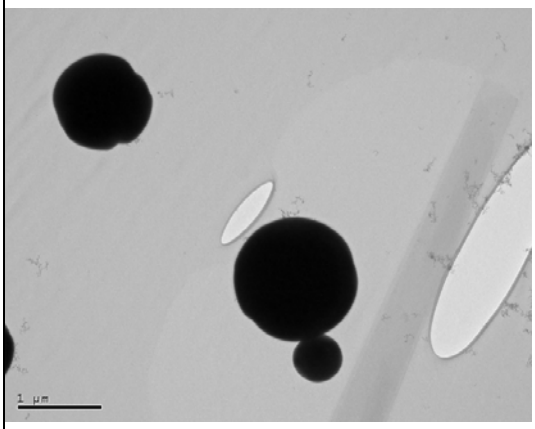

Figure 1. Micrograph shows super-micron size particles.