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Respirable Particle Transport from Surfaces by Shock Waves[1]
C.R. TRUMAN, P. VOROBIEFF, J. CONROY, P. WAYNE, R. WHITE, M. ANDERSON, U. New Mexico, S. KUMAR, U. Texas, Brownsville — Resuspension of particles from planar surfaces was studied in a shock tube. Respirable particles (aerodyn. diam.$\leq$ 5 μm) and slightly larger non-respirable particles were tested on smooth and rough surfaces at Mach 1.2 to 2.0. Particles of specified size were deposited on substrates of prescribed roughness. Surface roughness and particle-surface adhesion forces were quantified by atomic force microscopy. Alkylthiol self assembled monolayers (SAMs) were applied to precisely control surface roughness and surface chemistry. The advection of particles initially at rest on the surface by the rapidly accelerated flow were measured by Mie scattering. An ultra-high-speed digital camera with pulsed laser sheet illumination enables time-resolved particle transport diagnostics. Although particles are initially swept off a smooth surface with greater ease, cloud propagation speed is higher for a rough surface. At late times the cloud height is greater for a rough surface so that particles end up in a faster region of the boundary layer. Because our respirable and non-respirable particle size distributions overlap, further study is required. Shear-driven Kelvin-Helmholtz vortices clearly visible in some images likely play a prominent role in particle transport.

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