UNIVERSITY OF CALIFORNIA

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Ultrafine Particles and Freeways

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Environmental Health Sciences

by

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TABLE OF CONTENTS

LIST OF TABLES

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ABSTRACT OF THE DISSERTATION

Ultrafine Particles and Freeways

by

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Ultrafine particles (diameter < 100 nm) have been suggested as a possible causative agent for the observed increases in mortality and morbidity with increases in particulate matter (PM) concentrations. Systematic measurements of the concentration and size distribution of ultrafine particles were conducted in the vicinity of Interstate 405 (mostly gasoline traffic) and Interstate 710 (heavy-duty diesel traffic) in Los Angeles during the summer, 2001 and the winter 2002. Measurements were taken at

increasing distances downwind from each of the freeway. At each sampling location, concentrations of carbon monoxide (CO) and black carbon (BC) were also measured.

For the conditions of these measurements, relative concentration of CO, black carbon and particle number track each other well as one moves away from the freeway. Particle number concentration (6-220 nm) decreased exponentially with downwind distance from the freeway. The maximum number concentration that was observed near the freeway was about 25 time greater than that for the background location. It suggests that people, who live, work, or travel within 100 m downwind of major traffic sources, will have much higher ultrafine particle exposure than those who live farther away from such sources. The decay rates of CO and BC are slightly greater in summer than in winter for both freeways suggesting a weaker atmospheric dilution effect in winter. These data may be useful for epidemiological studies to estimate exposure to ultrafine particles in the vicinity of major highways and to evaluate their adverse health effects.

A mathematical model was developed to simulate ultrafine particle number concentrations and size distribution near freeways. The model predicts particle number concentration near freeways with more than 90% accuracy. There are significant discrepancies between the model predicted and measured ultrafine particle size distributions. Atmospheric dispersion was found to be the dominant mechanisms in determing the particle number concentration near freeways.