A Quantitative Risk Assessment in Workers Using Rodent Dose-Response Data of Fine and Ultrafine Titanium Dioxide

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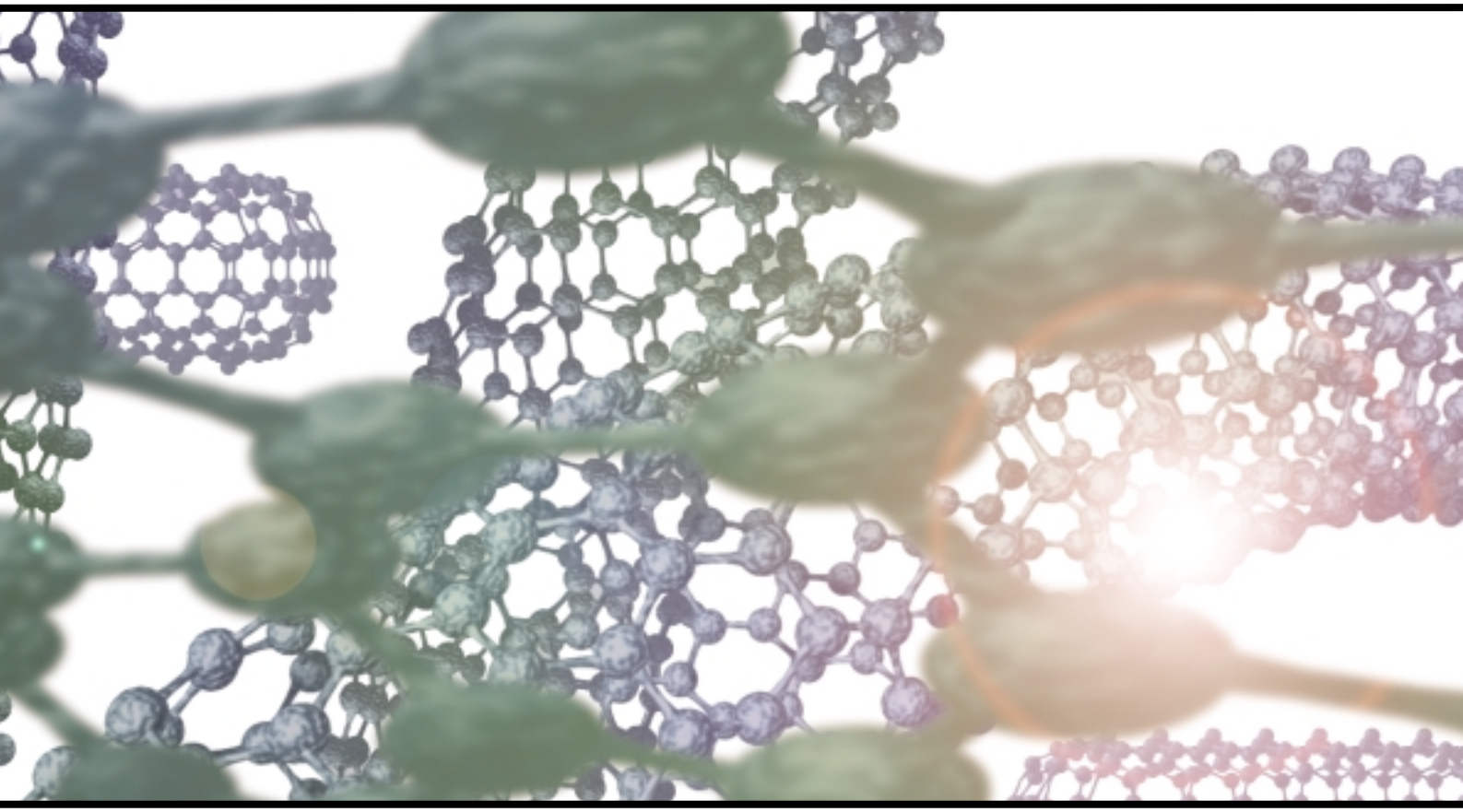
As with traditional materials, compared to the general population, workers may be exposed to the highest levels of nanomaterials. Under the assumption that the rat model is a useful predictor of human risk, we used data from published inhalation studies in rats exposed to titanium dioxide (TiO_2) in an exploratory risk assessment. The available data included fine/ultrafine particle fractions, chronic/subchronic exposures, and cancer/noncancer lung responses. The dose metric selected for these analyses was particle surface area dose in the lungs (converted from particle mass lung dose) because it is a strong predictor of pulmonary response to inhaled particles. Several statistical models were used to estimate the doses associated with specified excess risks of lung tumours. Approaches for synthesizing the risk estimates from these different models included Bayesian model averaging. Regression models were also fit to rat pulmonary inflammation data (measured as polymorphonuclear leukocyte, PMN, cell count in bronchoalveolar lavage fluid); and doses associated with the upper 5% of the distribution of PMNs in unexposed rats were estimated. Human lung dosimetry models were used to estimate the 45-year working lifetime mean exposure concentrations that would result in mass lung burdens equivalent to the particle surface area doses identified in the rat model (adjusting for species differences in lung tissue mass). Under these assumptions and modeling strategies, the maximum likelihood estimated working lifetime mean concentrations associated with a 1/1000 excess risk of lung tumors ranged from 0.9 to 11 mg/m^3 for fine TiO_2 and 0.07 to 1.0 mg/m^3 for ultrafine TiO_2. For pulmonary inflammation, these working lifetime concentration estimates varied from 1.4 to 2.6 for fine TiO_2 and 0.12 to 0.22 mg/m^3 for ultrafine TiO_2. These results reflect the greater toxicity observed in rodent studies of ultrafine particles compared to an equal mass of larger particles of similar composition.

Nanomaterials

a risk to health at work?



First International Symposium on Occupational Health Implications of Nanomaterials

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Report of Presentations at Plenary and Workshop Sessions and Summary of Conclusions

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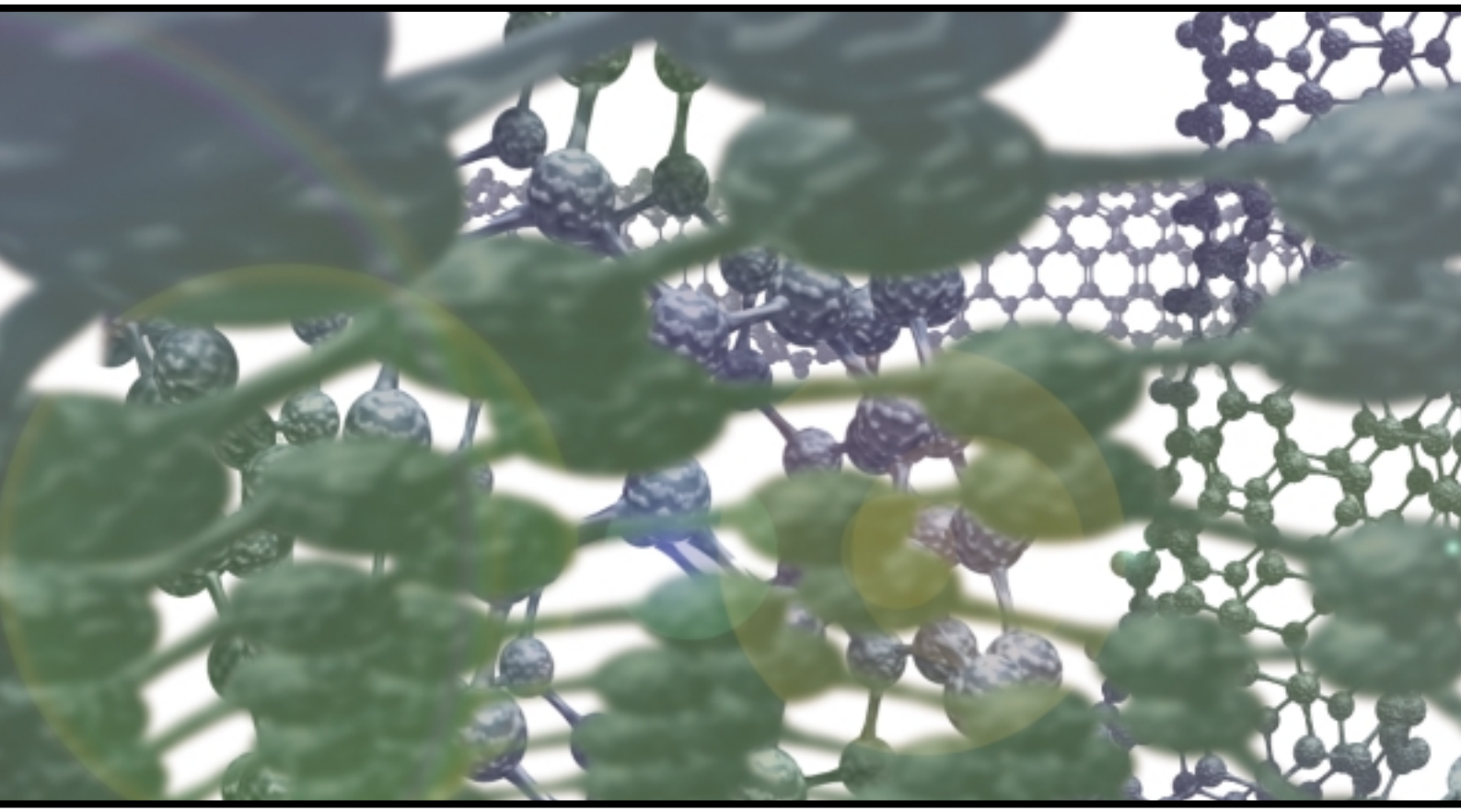

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