Coating aerosolized nanoparticles with low-volatile organic compound (LVOC) vapors modifies surface functionality and oxidative reactivity

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After releasing into the environment, Engineered nanoparticles (ENPs) have a high chance to react with other species; this process can change ENPs' physicochemical characteristics before human exposure. The modified surface functionality of ENPs can then influence their toxicity, including reactive oxygen species (ROS) generation, to be majorly dependent on the nature of the coatings picked up in the environment rather than ENPs' core. This study was dedicated to the understanding of toxicity from human exposure to airborne ENPs by investing this important but often neglected scenario. We developed a dynamic system to simulate the scenario by coating airborne ENPs with low-volatile organic compounds (LVOCs), common pollutants with a high affinity for surfaces. Measurement of airborne particle size distribution showed that ENPs' size increased after mixing with LVOC vapors. The coating thickness can be decided by the LVOC generator parameters. Transmission electron microscopy imaging and nanotracking analyses of ENPs suspended in liquid were also performed, confirming that the system yielded stable, replicable, and well controlled coating performance. ROS generation was found significantly depend on the nature and thickness of LVOC coating. Chemically non-reactive coatings can block reactive zones on the ENP surfaces and lead to ROS capacity reduction. In contrast, chemically reactive coatings can contribute to the redox cycle and lead to ROS formation enhancement. Our results further demonstrate ENPs' surface functionality plays a predominant role in nanotoxicity. Furthermore, our high controllable ENP coating system may find useful applications introducing desirable surface in the field of nano-medicine.