Idling airplanes produce more harmful pollution than previously thought

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Credit: Magnus Rosendahl, Public-domain-photos.com

(PhysOrg.com) -- A group of researchers from Carnegie Mellon University in Pittsburgh, have shown that the emissions produced by aircraft idling at the gate, or lining up for takeoff, contain tiny oil droplets, that when exposed to ordinary sunlight, undergo a chemical reaction that causes them to solidify into tiny particles that can infiltrate the lungs and eventually the brain.

In a paper published in Atmospheric Chemistry and Physics, the team led by Allen Robinson, describe how they collected samples of exhaust from an idling KC-135 military cargo plane, into large Teflon coated bags, and how they then exposed that exhaust to sunlight and/or UV light to initiate photo-oxidation (when a polymer surface degrades in oxygen or ozone). The result, they say, was that the original droplets of oil were converted into multiple minute solid particles, small enough to penetrate the lungs and brain of people working or living near airports.

In contrast, exhaust emissions from airplanes running at speed, such as when in-flight, tend to be mostly comprised of solid particles, which would not be effected by sunlight in the same way, and thus would pose no additional health hazards over what is already known about such types of pollution.

The paper highlights the fact that airplane pollution, and specifically the kind produced at airports, is in stark contrast to other types of pollution emitters such as cars and manufacturing plants, in that little to nothing has been done to reduce the amounts spewed into the environment. It also shows that the type of pollution produced at airports is far more hazardous than was previously thought; but, because these findings are so new, it's likely no research has yet been conducted to ascertain what exactly happens to the human body when these tiny particles are breathed in on a regular basis.

The authors also mention in their paper, the folly of studying emissions from aircraft (or presumably any other pollution emitters for that matter) without following up to find out what becomes of such pollutants as they enter the environment and are affected by such forces as UV radiation, temperature, or other substances.

More information: Secondary aerosol formation from photochemical aging of aircraft exhaust in a smog chamber, *Atmos. Chem. Phys.*, 11, 4135-4147, 2011 doi:10.5194/acp-11-4135-2011

Abstract
Field experiments were performed to investigate the effects of photo-oxidation on fine particle emissions from an in-use CFM56-2B gas turbine engine mounted on a KC-135 Stratotanker airframe. Emissions

were sampled into a portable smog chamber from a rake inlet installed one-meter downstream of the engine exit plane of a parked and chocked aircraft. The chamber was then exposed to sunlight and/or UV lights to initiate photo-oxidation. Separate tests were performed at different engine loads (4, 7, 30, 85 %). Photo-oxidation created substantial secondary particulate matter (PM), greatly exceeding the direct PM emissions at each engine load after an hour or less of aging at typical summertime conditions. After several hours of photo-oxidation, the ratio of secondary-to-primary PM mass was on average 35 ± 4.1, 17 ± 2.5, 60 ± 2.2, and 2.7 ± 1.1 for the 4, 7, 30, and 85 % load experiments, respectively. The composition of secondary PM formed strongly depended on load. At 4 % load, secondary PM was dominated by secondary organic aerosol (SOA). At higher loads, the secondary PM was mainly secondary sulfate. A traditional SOA model that accounts for SOA formation from single-ring aromatics and other volatile organic compounds underpredicts the measured SOA formation by ~60 % at 4 % load and ~40 % at 85 % load. Large amounts of lower-volatiliy organic vapors were measured in the exhaust; they represent a significant pool of SOA precursors that are not included in traditional SOA models. These results underscore the importance of accounting for atmospheric processing when assessing the influence of aircraft emissions on ambient PM levels. Models that do not account for this processing will likely underpredict the contribution of aircraft emissions to local and regional air pollution.