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Science feature

Nano hazards inside homes

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Indoor pollution from combustible sources is more sinister than hitherto believed, research by a chemistry professor at the Indian Institute of Technology (IIT) in Kanpur has revealed.

Sabyasachi Sarkar has discovered that the products of combustion of domestic fuels include 'defective' carbon nanotubes. Inhalation of these so called 'spin frustrated carbon nanotubes (SFCNT)' floating indoors can trigger asthma attacks and aggravate suffering in those who are already asthma patients, he reports¹.

The SFCNT are released from the burning of biomass, kerosene, oil, gas and coal in the kitchen, or candles and incense sticks used in prayer rooms of Indian homes, Sarkar says.

Sarkar employed an innovative technique to find out the constituents in the domestic aerosols by using indoor spider webs to capture the circulating airborne particulates. For his analysis he collected one-day to two-weeks old spider webs from inside the houses of staff residing in the IIT campus.

The webs were chemically treated to remove the particulate matter and the black residue was subjected to a battery of X-ray and spectroscopic analysis to determine its composition.

The transmission electron microscope image of the purified residue showed the presence of SFCNT — multiwall carbon nanotubes of diameter ranging from 20-50 nm with "several turns and junctions and uneven obstructions present in the channels," Sarkar reported.



The spider web loaded with nanotubes.

Additionally, 'electron paramagnetic resonance' spectroscopic measurements of SFCNT revealed the presence of reactive carbon radicals trapped inside the turns and kinks of the nanotubes. "Retention of these carbon radicals inside the SFCNT even after harsh acid purification treatments suggest the highly stable nature of these radicals," says Sarkar.

Through another investigation, called 'nitro blue tetrazolium' test, Sarkar demonstrated that SFCNT can activate oxygen present in the air to produce 'superoxide radicals' which are potent reactive oxygen species implicated in cellular activity to a variety of inflammatory responses including cardiovascular disease.

The catalytic action of these nanotubes in generating superoxide radicals strongly suggests these may react with oxygen in the lungs triggering inflammatory type activation, Sarkar says. Being small and insoluble SFCNT can penetrate the deepest areas of the lungs.

"Degradation of SFCNT is difficult and its size may not allow ready precipitation causing its gradual



Sabyasachi Sarkar

accumulation in indoor aerosols which on exceeding threshold may lead to catastrophic consequences," warns Sarkar.

He says the nano hazard from indoor pollution is real since most Indians spend approximately 90 per cent of their time indoors. His project was supported by the nanoscience and technology initiative scheme of the government Department of Science and Technology.

References

1. Sonkar, S. K. *et al.* Activation of aerial oxygen to superoxide radical by carbon nanotubes in indoor spider web trapped aerosol. *Curr. Sci.* **97**, 1227-1230 (2009)

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