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3rd hand smoking; heterogeneous oxidation of nicotine and secondary aerosol formation in the indoor environment

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Tobacco smoking is well known as a significant source of primary indoor air pollutants. However, only recently has it been recognized that the impact of Tobacco smoking may continue even after the cigarette has been extinguished (i.e., third hand smoke) due to the effect of indoor surfaces. These surfaces may affect the fate of tobacco smoke in the form of secondary reactions and pollutants, including secondary organic aerosol (SOA) formation.

Fourier Transform Infrared spectrometry with Attenuated Total Reflection (FTIR-ATR) in tandem with a Scanning Mobility Particle Sizing (SMPS) system was used to monitor the ozonation of cellulose sorbed nicotine and resulting SOA formation. SOA formation began at onset of ozone introduction ([O_3] = 60 $\pm$ 5 ppb) with a size distribution of $d_p \leq 25$ nm, and was determined to be a result of heterogeneous reaction (opposed to homogeneous). SOA yield from reacted surface nicotine was on the order of 10 %.

Simultaneous to SOA monitoring, FTIR-ATR spectra showed surface changes in the nicotine film as the reaction progressed, revealing a pseudo first-order surface reaction rate of 0.0026 $\pm$ 0.0008 min^{-1}. Identified surface oxidation products included: cotinine, myosmine, methylnicotinamide and nicotyrine. Surface reaction rate was found to be partially inhibited at high relative humidity.

Given the toxicity of some of the identified products (e.g., cotinine has shown potential mutagenicity and teratogenicity) and that small particles may contribute to adverse health effects, the present study indicates that exposure to 3^{rd} hand smoke ozonation products may pose additional health risks.