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Photoactive roadways: Determination of CO, NO and VOC uptake coefficients and photolabile side product yields on TiO₂ treated asphalt and concrete

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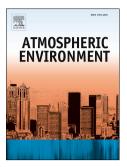
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Photoactive Roadways: Determination of CO, NO and VOC Uptake 1 Coefficients and Photolabile Side Product Yields on TiO₂ Treated Asphalt and 2 3 Concrete. 4 C. Toro¹, B.T. Jobson^{1*}, L. Haselbach², S. Shen³, and S.H. Chung¹ 5 6 ¹Laboratory for Atmospheric Research, Department of Civil and Environmental Engineering, Washington State University, Pullman, Washington 7 ²Department of Civil and Environmental Engineering, Washington State University, Pullman, 8 Washington 9 ³Department of Engineering, Pennsylvania State University, Altoona, Pennsylvania 10 11 12 *Corresponding author: tjobson@wsu.edu 13

14 ABSTRACT

15 This work reports uptake coefficients and by-product yields of ozone precursors onto two 16 photocatalytic paving materials (asphalt and concrete) treated with a commercial TiO₂ surface application product. The experimental approach used a continuously stirred tank 17 18 reactor (CSTR) and allowed for testing large samples with the same surface morphology encountered with real urban surfaces. 19 The measured uptake coefficient (γ_{geo}) and surface 20 resistances are useful for parametrizing dry deposition velocities in air quality model 21 evaluation of the impact of photoactive surfaces on urban air chemistry. At 46% relative humidity, the surface resistance to NO uptake was ~ 1 s cm⁻¹ for concrete and ~ 2 s cm⁻¹ for a 22 freshly coated older roadway asphalt sample. HONO and NO₂ were detected as side products 23 from NO uptake to asphalt, with NO₂ molar yields on the order of 20% and HONO molar 24 yields ranging between 14-33%. For concrete samples, the NO₂ molar yields increased with 25 26 the increase of water vapor, ranging from 1% to 35% and HONO was not detected as a by-27 product. Uptake of monoaromatic VOCs to the asphalt sample set displayed a dependence on the compound vapor pressure, and was influenced by competitive adsorption from less 28 volatile VOCs. Formaldehyde and acetaldehyde were detected as byproducts, with molar 29 30 yields ranging from 5-32%.

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