Researchers get new view of how water and sulfur dioxide mix

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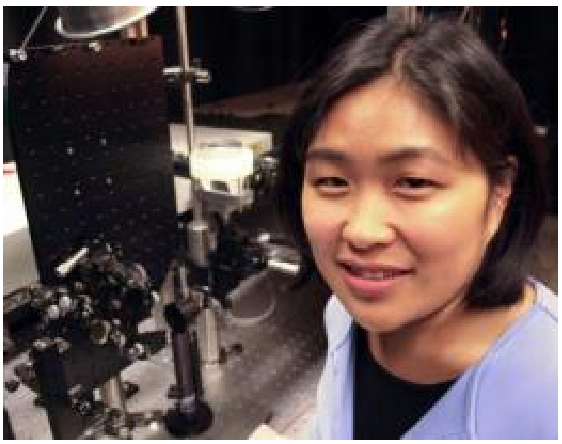

Stephanie T. Ota, a doctoral student at the University of Oregon, has completed experiments that show how surface water molecules, such as those on clouds, interact with sulfur dioxide at cool high-atmospheric temperatures. Credit: University of Oregon

High in the sky, water in clouds can act as a temptress to lure airborne pollutants such as sulfur dioxide into reactive aqueous particulates. Although this behavior is not incorporated into today's climate-modeling scenarios, emerging research from the University of Oregon provides evidence that it should be.

The role of sulfur dioxide -- a pollutant of volcanic gasses and many combustion processes -- in acid rain is well known, but how sulfur dioxide reacts at the surface of aqueous particulates in the atmosphere to form acid rain is far from understood.

In National Science Foundation-funded laboratory experiments at the UO, chemistry doctoral student Stephanie T. Ota examined the behavior of sulfur dioxide as it approaches and adsorbs onto water at low temperatures that mimic high-atmospheric conditions. Using a combination of short-pulsed infrared and visible laser beams, she monitored the interaction of sulfur dioxide with water as it is flowed over a water surface.

The results -- detailed online ahead of regular publication in the Journal of the American Chemical Society -- show that as sulfur dioxide molecules approach the surface of water, they are captured by the top-most surface water molecules, an effect that is enhanced at cold temperatures.

Although this reaching out, says co-author Geraldine L. Richmond, professor of chemistry, provides a doorway for sulfur dioxide to enter the water solution, the weak nature of the surface-bonding interaction doesn't guarantee that the water temptress will be successful.

"We have found that that the sulfur dioxide bonding to the surface is highly reversible and does not necessarily provide the open doorway that might be expected," Ota said. "For example, for highly acidic water, the sulfur dioxide approaches and bonds to the water surface but shows little interest in going any further into the bulk water."

The uptake of gases like sulfur dioxide has important implications in understanding airborne pollutants and their role in global warming and climate change. Sulfur dioxide that has come together with water, becoming aqueous, reflects light coming toward the planet, while carbon dioxide accumulating in the atmosphere traps heat onto the planet.

Understanding the interaction of surface water molecules, such as those in clouds and fog, with pollutants rising from human activity below may help scientists better predict potential chemical reactions occurring in the atmosphere and their impacts, said Richmond, who was elected May 3 as a member of the National Academy of Sciences.

"In the past we presumed that most chemistry in the atmosphere occurred when gas molecules collide and react," she said. "These studies are some of the first to provide molecular insights into what happens when an atmospherically important gas such as sulfur dioxide collides with a water surface, and the role that water plays in playing the temptress to foster reactivity."

Provided by University of Oregon

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