

UC SANTA BARBARA

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CHEMISTS REPORT ON ELECTRON TRANSFER IN SCIENCE MAGAZINE

Electronics devices, solar energy conversion, and many biological processes depend upon electron transfer reactions which move charge between molecules.

Understanding of how molecular vibration influences electron transfer, an important aspect of the field of chemistry, has moved forward significantly with research conducted in the Department of Chemistry at the University of California, Santa Barbara, and published in this week's Science magazine.

"Basically, we discovered that for a split second, stretched molecules behave a little like atoms," said Alec M. Wodtke, professor of chemistry at UC Santa Barbara. The experiments took place in Wodtke's lab. Yuhui Huang, of UC Santa Barbara, is the first author. Second and third authors are from the IBM Research Division in San Jose, Calif.

There are two ways to influence electron transfer; one is with the solvent and the other is with vibration. Until now, it has been difficult to design clean experiments that could sort out and show the effects of vibration on electron transfer," said Wodtke.

"To imagine what we did, think of a simple molecule composed of two atoms that are like balls linked together by a spring," said Wodtke. "When you give them a lot of vibrational energy, the atoms that were close together

are stretched far apart. At a certain point they stop acting like molecules and start acting like free atoms. Molecules and free atoms can have very different properties, for example, atoms have a strong propensity to accept electrons."

As they state in the article, "The prototypical process of electron transfer is one of the most fundamental elementary chemical reactions found in nature." But as Wodtke explained, it has been very difficult to discern which of the two possible influences were responsible for the transfer of electrons, solvent or vibration.

"We found a way to at once remove the complicating effects of the solvent and to control the vibrational state of the reacting molecule by studying electron transfer dynamics between an incident gas molecule and a metal surface," said the authors.

With this research, valuable data have become available that will help in the improvement of the theory of electron transfer. Hence a wide variety of processes can be understood, said Wodtke.

Wodtke's team used three tunable laser systems and an ultra high vacuum surface science machine to do these experiments. The work is part of an ongoing collaboration with the IBM Almaden Research Center. "This research is both a good example of the kind of interdisciplinary research going on at UCSB and an example of how university and industrial researchers can have productive collaborations," said Wodtke.

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.