Groundbreaking research could ignite new solutions to heat transfer in nano-devices

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For the first time, an innovative research technique successfully completed a detailed measurement of **how heat energy is created at the molecular level, an approach that could have far reaching implications for developing** nano-devices.

Research results to be published in the upcoming issue of Science, detail a collaborative effort involving The University of Scranton, a Jesuit university in Pennsylvania, and the University of Illinois at Urbana-Champaign, a research institution in Illinois.

"This is the first time that anyone has measured how a specific motion of a molecule on one side of a molecular wall causes molecules within the wall to move," said John Deak, Ph.D., assistant professor of chemistry at The University of Scranton. "In nanotechnology, researchers design materials whose properties originate in clusters of molecules on the nanometer level. This research can be used to help us better understand how molecules interact on these dimensions."

The faculty and students involved were Dr. Deak and his undergraduate student Timothy Sechler; and University of Illinois chemistry professor Dana Dlott, Ph.D., Yoonsoo Pang, graduate assistant, and Zhaohui Wang, post-doctoral research associate.

"The experiment detailed the pathways for energy transfer and also provided the tools to study other molecules," said Dr. Dlott. "In designing nanoscale devices, the shapes of the molecules must be

designed not only to be small and fast, but also to move heat effectively. There is no reason that this technique is not applicable to just about any molecule."

Key to the discovery was the collaboration between the faculty members of both institutions of higher learning. A research concept developed at Scranton was put in practice using an advanced laser technology called IR Raman Spectroscopy at the University of Illinois. The laser measures the behavior of molecules in nanometer size spaces.

Included among the research scientist authors is Timothy D. Sechler, an undergraduate student at The University of Scranton's Dexter Hanley College for adult students.

"This project gave me the opportunity to see what my future would be like if I pursue a research track," said Mr. Sechler, a junior who now plans to pursue a Ph.D. in chemistry.

The research used vibrational spectroscopy with picosecond time resolution to monitor the flow of energy across surfactant molecules that separate droplets of confined water from a nonpolar liquid phase. Their research shows that the surfactant layer must be analyzed in terms of its vibrational couplings, rather than by ordinary heat conduction. Their research provided the first detail of the precise pathways for interfacial vibrational energy in both time and space resolution.

The paper, entitled "Vibrational energy transfer across a reverse micelle surfactant layer," will be published in the October 15 issue of Science, the prestigious journal of the American Association for the Advancement of Science, and on the Science Express Web site on Sept. 23, 2004.

Source: University of Scranton