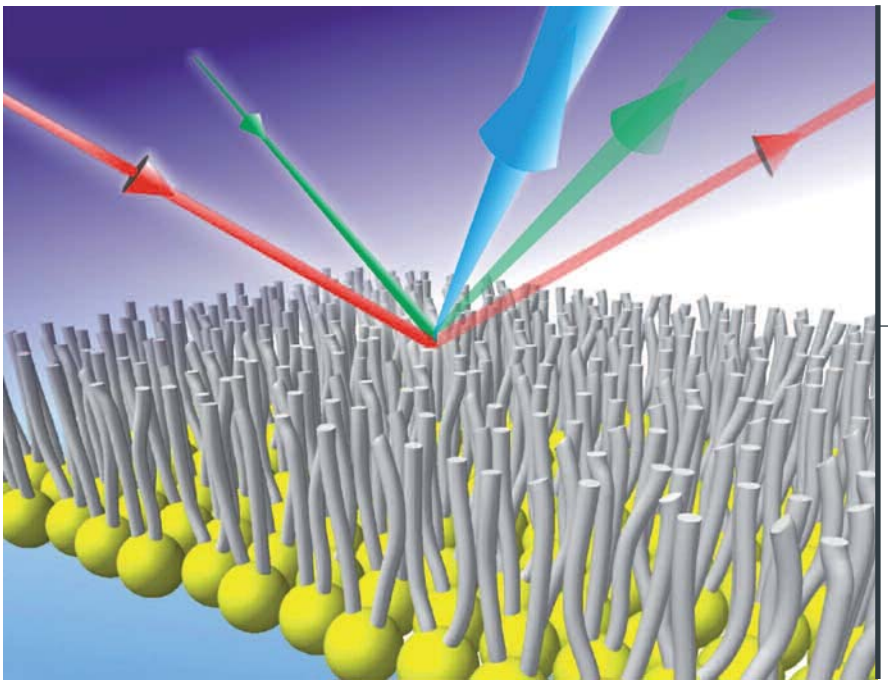
Molecular dynamics in model biological membranes

The cell membrane does more than just separating the inside and outside of the cell. It constitutes a highly active barrier, which controls, for instance, transport in and out of the cell. This is possible through a subtle, dynamic interplay between the key molecular components of the membrane: lipids, membrane proteins and the surrounding water. Experimental information on the biomolecular dynamics in cell membranes has been lagging, despite the evident importance, due to the challenge associated with the specific investigation of interfacial molecules that constitute the membrane, with sufficient time resolution.

Using femtosecond laser spectroscopy direct access to biomolecular dynamics in model membranes is obtained, by investigating the evolution of the biomolecular system in real-time following a laser-pulse induced change (*e.g.* temperature jump or vibrational excitation). The strength of the approach lies in its inherent sensitivity to interfacial phenomena at the level of single molecular layers.

The vibrational energy relaxation and energy transfer in a simplified model system for a biological membrane reveal remarkably fast dynamics: the transfer of heat across half a membrane, for instance, occurs on picosecond timescales. These results demonstrate the potential of using ultrafast surface spectroscopies to elucidate biomolecular dynamics at membrane surfaces. ■

M. Smits, **A. Ghosh**, **J. Bredenbeck**, **S. Yamamoto**, **M. Müller** and **M. Bonn**, "Ultrafast energy flow in model biological membranes", *New J. Phys.* **9**, 390 (2007).



◀ Schematic of the experiment: A self-assembled monolayer of lipid molecules (with polar headgroups shown in yellow and apolar alkyl chains shown in grey) on water. Laser pulses at different wavelengths are incident on the lipid monolayer. One pulse triggers a temperature jump or vibrational excitation in the monolayer, and a delayed pair of pulses interrogates the transient changes in the monolayer, in a process where the sum-frequency of the incident pair (shown here as red and green) is generated (blue beam). This technique provides surface-specific information on model membrane relaxation processes.

The reaction $^{48}Ca+^{238}U \rightarrow ^{286}112^*$ studied at GSI-SHIP

The first successful hot-fusion experiment at GSI on the synthesis of a super-heavy element has been carried out by the team lead by S. Hofmann. The GSI team is well known for their cold-fusion reaction experiments in studying the production and decay properties of the heaviest elements up to Z=112.

By bombarding a ^{238}U target with a beam of ^{48}Ca ions they identified the decay of $^{283}112$ nuclide in agreement with two previous studies conducted in Dubna, one employing the gas-filled recoil separator and the other one employing chemical separation. Good agreements on both the alpha-decay energy as well as the half-life were observed in all three experiments. The cross section determined in the GSI experiment is 0.72 (+0.58,-0.35) pbarn which is in reasonable agreement with a slightly higher cross section of 2.5 (+1.8,-1.1) pbarn of the Dubna experiment. However, even with the new result a link via a decay chain to any well-known heavy isotope still remains missing.

The new GSI experiment is an important landmark in paving the way to future experiments on the synthesis of superheavy elements beyond Z=112 and the question of the existence the super-heavy island of stability. The result is of particular importance because it represents the first confirmation experiment conducted outside of Dubna employing hot-fusion reactions in super-heavy element synthesis. Dubna experiments, that have resulted in great amount of data on synthesis and decay properties of superheavy nuclei up to Z=118, are now confirmed for the decay chain of one isotope by this independent experiment which employed the velocity filter SHIP and the UNILAC accelerator. The result obtained will intensify further experimental efforts around hot-fusion experiments. ■

Sigurd Hofmann *et al.* (26 co-authors), "The reaction $^{48}Ca+^{238}U \rightarrow ^{286}112^*$ studied at GSI-SHIP", *Eur. Phys. J. A* **32**, 251 (2007)