Press Release
20th September 2007

Because we are made of sugar candy
The 2007 Ernst Schering Prize is awarded to Carolyn R. Bertozzi for her outstanding research in the field of chemical glycobiology at the cell surface.

Professor Carolyn R. Bertozzi from the University of California, Berkeley, will receive the 2007 Ernst Schering Prize for her outstanding research in the field of chemical glycobiology. She has developed methods that allow, for the first time, to specifically recognize and monitor changes in sugar structures at the cell surface using chemical tools. This particular field of science, although of great significance for the recognition of glycosylation patterns associated with illnesses (i.e. cancer or infectious diseases), is still inadequately researched. The laureate will receive the 50.000 Euro prize awarded by the Ernst Schering Foundation at a ceremony in Berlin today.

Which sugar moieties – the accurate terms are glycans or oligosaccharides – are attached to which proteins? How do glycosylation patterns change as diseases take their course? Does the pattern change over the course of a person's lifetime? Will we find a sugar code, comparable to the genetic code? These are just some of the questions professor Carolyn R. Bertozzi is trying to answer. With her investigations she has pushed the boundaries of science further than anyone in her field before her. Glycobiology – the study of sugar moieties and their function used to be an orphan topic. Few researchers were willing to take the risks inherent to this field of science. Most scientists thought it too complex, the oligosaccharide structural diversity far too large, and overall, the whole topic was thought to be technically too difficult.
Carolyn Bertozzi however came up with an ingenious trick: applying chemical methods to biological problems, she was able to manipulate the vastly branched and complex oligosaccharides of proteins. Through incorporation of exogenously applied small molecules – so called bioorthogonal chemical reporter molecules – into glycoconjugates using the cells own machinery, she was able to visualize the glycan moieties of proteins and lipids at any location of the cell.

It is estimated that more than 50 percent of proteins in the human body are glycosylated. Many glycosylated proteins can be found at the cell surface, where the so called glycoproteins are key players in metabolic and communication processes of the cell. Furthermore many proteins of the nucleus as well as a majority of secreted proteins are glycosylated. Since it has been near impossible to study the biological roles of oligosaccharides, almost no knowledge of their function, glycosylation patterns, or changes in glycosylation during of the course of disease or the process of aging exists to date. "We compare the composition, localization, and function of glycoproteins within the cell membrane in healthy cells to those in diseased cells like cancer cells. Thus we hope to develop methods, which will allow us to tackle diseased cells directly without any impact on healthy cells", says Carolyn Bertozzi.

The bioorthogonal chemical reporters are non-native, non-perturbing chemical handles consisting of small sugars, also called monosaccharides. The completion of the human genome in 2001 made it perfectly clear that the number of genes an organism carries cannot be in itself responsible for a species complexity – as the following comparison shows: yeast – 6.000 genes; the nematode *C. elegans* – 15.000 genes; fruit fly 20.000 genes; human ~ 25.000 genes. Only posttranslational modifications – chemical transformations of proteins such as glycosylation - can explain the level of complexity observed. The human body makes approximately 300.000 protein species from the 25.000 genes found in the genome. Genes transcribed and translated by the cells' machinery are then further modified by changing their shapes and altering their structures. Protein folding occurs, parts are either spliced off or added, and different molecules like lipids and glycans are attached. "Bioorthogonal chemical reporters blend the simplicity of genetically encoded tags like Green Fluorescent Protein (GFP) with the specificity of antibody labelling and the versatility of small-molecule probes. This allows the visualization of proteins, lipids and glycans alike", explains professor Bertozzi. They now make it possible to study the posttranslational changes and thus contribute to a better understanding of living systems.

In addition to studying glycosylation with chemical tools and applications to cancer therapy, Bertozzi is working on another global health threat – *Mycobacterium tuberculosis* – the causative agent of tuberculosis. It is estimated that one third of the world's population is infected and two million people die of it every year. Bertozzi's research group mainly focuses on the enzymes involved in sulfur metabolism. For example, Bertozzi's research indicates that phosphosulfate reductases, enzymes that reduce sulfur, are critical for maintaining virulence in the persistent phase of tuberculosis infection, a non-replicative state in which the bacteria remain for decades within the host. She hopes that by shutting off this enzyme, the pathogen might be eliminated in its latent state. This would be an immense advance in tuberculosis therapy, since it would no longer be necessary to wait for reactivation of the disease. Resources currently used for expensive, yet often ineffective antibiotic treatment could be put to a better cause. Through combination of different methods from small molecules, genetics, biochemistry and mouse pathogenesis models Bertozzi has now been able to identify another enzyme, a sulfotransferase, as important for the pathogen's communication with the host. Further research might elucidate the mechanisms by which the bacterium regulates the host's immune response.

The person Carolyn R. Bertozzi

Carolyn R. Bertozzi was born in 1966 in Boston, USA. She studied organic chemistry at Harvard University and obtained a PhD from the University of California, Berkeley, under the supervision of Professor Mark Bednarski in 1993. During her time as a postdoctoral fellow at the University of California, San Francisco, funded by the American Cancer Society, Bertozzi learned to apply her chemical knowledge to biological problems. Carolyn Bertozzi comes from a family of scientists. Her father, who is a professor for physics at the Massachusetts Institute of Technology (MIT), frequently took his three daughters to the lab or sent them to MIT summer camps. Not surprisingly two of them went on to become academic scientists. Looking back Carolyn Bertozzi says: "We were expected to be scientists in my family. My older sister is a professor for mathematics, my younger sister is an occupational therapist. I did not come across the infamous invisible barrier that women in science often encounter. Or maybe I just ignored it." Her piece of advice to young scientists today: "Find out what you are most interested in and pursue it without paying too much attention to trends and hypes. The passion that comes from working on something you really care about is the best fuel for success in science."

The Schering Foundation

The non-profit Ernst Schering Foundation honors excellent accomplishments in the life sciences and in arts and culture. Presenting role models to provide inspiration is the theme that also applies to the annual award of the Ernst Schering Prize. The Ernst Schering Prize for particularly outstanding work in the field of scientific basic research was established by the Ernst Schering Research Foundation in 1991 and is awarded annually. Since 2003, the prize is awarded by the Ernst Schering Foundation.

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As part of the award ceremony Professor Bertozzi will give a lecture on the 21st of September 2007 at 10 am to high school students of the Humboldt Gymnasium, Berlin Tegel. Further information can be obtained from Dr. Harald Paland or headmaster: Dr. Hinrich Lühmann, Ph.: +49 30 433 70 08

This is followed by an open lecture at 4 pm at the Technical University of Berlin (TU), Building C Lecture theater C 243, Straße des 17. Juni 115, Contact person is Prof. Schwarz: Helmut.Schwarz@mail.chem.tu-berlin.de, Ph: +49 30 314 23483