**Seminar**

Paul G. Gassman Lectureship in Chemistry #1

4 p.m.
Monday, Oct. 22, 2018
331 Smith Hall

---

**Carbon Nanostructures – the Future is not Black**

**Professor Emeritus Klaus Müllen**

Max Planck Institute for Polymer Research

Host: Professor Christopher Douglas

The title does not concern the many political crises in the world; the question is rather what materials research has to offer in pushing technologies towards meeting future societal needs.

Carbon materials are of immense practical importance, but are often known as structurally ill-defined “black stuff” such as soot. In another case, carbon nanofibers (CNFs) are important for the reinforcement of polymers and thus serve as stiff additives for lightweight, but mechanically strong construction materials. The fabrication of CNFs is still in urgent need of new chemistry. Graphenes and graphene nanoribbons (GNRs), their geometrically restricted cutouts, are new additions to the carbon family which are widely praised as multifunctional wonder materials and rich playgrounds for physicists. Indeed, graphenes hold enormous promise as materials for energy technologies. Furthermore, GNRs are regarded as a new generation of semiconductors, and we shall come back to their role for device fabrication in the third talk on electronic materials.

Above all, however, graphene, as a two-dimensional polymer, and GNRs are true challenges for materials synthesis. Herein, we approach graphene fabrication in two steps. “Top-down” protocols such as electrochemical exfoliation are applied for batteries, fuel cells and photodetectors. In the “bottom-up” synthesis of GNRs, repetitive cycloaddition reactions in solution are shown to afford multi-branched polyphenylene polymers which then serve as precursors for perfectly “graphitized”, solution-processable GNRs as long as 600 nm. An alternative on-surface synthesis utilizes immobilization of suitable monomers and in-situ STM-control of the polymerization to secure structural perfection.

Thus, it is a synthetic breakthrough which leads to new materials science and physics. The present fundamental study is far away from robust technologies, but an attempt can be made at predicting some future trends.

**Reception immediately follows this seminar: 5-6:30 p.m.**

Conference Rooms ABC (4th floor Coffman Memorial Union)

---

**Klaus Müllen** was director at the Max Planck Institute for Polymer Research. He now holds an emeritus position for continuation of his research there and is fellow of the Gutenberg Research College of Mainz University. His broad research interests range from new polymer-forming reactions, to the chemistry and physics of single molecules as well as graphenes, dendrimers and biosynthetic hybrids. He published about 1,900 papers. He received the Max Planck Forschungspreis, Philip Morris Forschungspreis; Nozoe-Award; Science Award of the “Stifterverband”; Innovation Award of the State of North Rhine Westphalia; Nikolaus August Otto Award; Society of Polymer Science Japan International Award; American Chemical Society (ACS) Award in Polymer Chemistry; Tsungming Tu Award, Taiwan; BASF-Award for Organic Electronics; Franco-German Award of the Société Chimique de France; Adolf-von-Baeyer-Medal; Utz-Hellmuth-Felcht Award, SGL Group; China Nano Award; Carl Friedrich Gauß-Medal, van’t Hoff Award of the Royal Netherlands Academy of Sciences as well as the Hermann-Staudinger Award and the Award of the Academy of Sciences and Humanities in Hamburg. From 2008-09, he served as president of the German Chemical Society (GDCh). In 2013-14, he was president of the German Association for the Advancement of Science and Medicine. He is member of the American Academy of Arts & Sciences, North-Rhine-Westphalian Academy for Sciences and Art, National Academy Leopoldina, European Academy of Sciences, Braunschweigische Wissenschaftliche Gesellschaft and Academia Europaea. In 2010, he received an Advanced European Research Grant for his work on nanographenes. He is associate editor of the *Journal of the American Chemical Society.*

---

**Regents Professor Paul G. Gassman** died in April 1993, at the age of 57. He was internationally known in the chemical community, and left behind a legacy of achievement. During his career, he served as mentor and adviser to 85 doctoral and master’s candidates as well as dozens of postdoctoral associates and undergraduate students. Numerous awards, honors, and honorary degrees were bestowed in recognition of his contributions to research and his service to the scientific, professional, and university communities. Some of these awards include election to the National Academy of Sciences (1989) and to the American Academy of Arts and Sciences (1992); the James Flack Norris Award in Physical Organic Chemistry (1985); Arthur C. Cope Scholar Award (1986); and the National Catalyst Award of the Chemical Manufacturers Association (1990). He served as president of the American Chemical Society in 1990. He was co-chair of the organizing committees of the National Organic Symposium (1991) and the National Conferences on Undergraduate Research meeting (1992), on the University of Minnesota campus. It was his wish that a lectureship be established to bring distinguished organic chemists to the Department of Chemistry. We are proud to present this lecture series in his honor.