SOMER LECTURES

How can we keep Mars rover clean?

Dr. Dirk J. Broer

Professor at Eindhoven University of Technology
Department of Chemical Engineering & Chemistry
Laboratory for Functional Organic Materials & Devices (SFD)
Institute for Complex Molecular Systems (ICMS)

Thursday, November 8, 2018 14:00

METU Department of Chemical Engineering Z-14

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TARIK SOMER EĞİTİM VAKFI

60TH ANNIVERSARY CHEMICAL ENGINEERING

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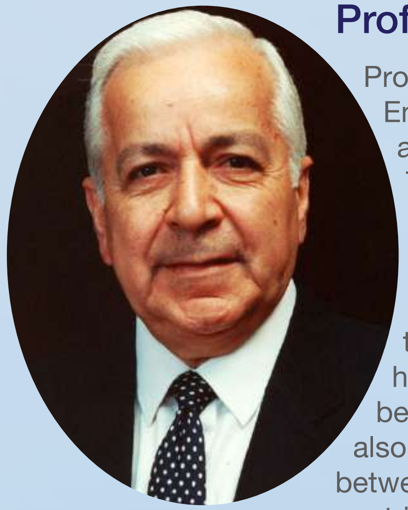
SOMER LECTURES



Prof. Dr. Tarık G. Somer (1926 - 1997)

Prof. Dr. Tarık G. Somer is the founder of Department of Chemical Engineering at Middle East Technical University (METU), and he is also the initiator of modern chemical engineering education in Turkey. After getting his B.S., M.S. and Ph.D. degrees from RPI, MIT and University of Maryland, he worked as a research engineer between 1954 - 1956.

He was appointed as the Professor and the founding chairman of the Department of Chemical Engineering at METU in 1957. He had worked as the President of METU and Ankara University between the years 1974 - 1976 and 1982 - 1987, respectively. He also served as the President of Council of Turkish Universities between 1984 - 1985. Being the chief technical advisor of UNESCO, he contributed to the establishment of the university system in Uganda. He also worked in Technische Hochschule Darmstadt as a Visiting Professor. Besides his memberships in a number of professional societies, he was also a member of Union of Presidents of European Universities Chemistry Research.

Dr. Dirk J. Broer

Dirk J. Broer is a polymer chemist specialized in polymer structuring and self-organizing polymer networks. In 1973, he joined Philips Research (Eindhoven, Netherlands) where he worked on vapor phase polymerization, optical data storage, telecommunication and display optics. In 1990/1991, he worked at DuPont Experimental Station (Delaware, USA) on nonlinear optics. He started his work on liquid crystal materials in 1985. He developed the process of in-situ photopolymerization of liquid crystal monomers to form densely crosslinked and monolithically ordered liquid crystal networks which led in 1990 to his PhD degree at Groningen University. Back in 1991 at Philips Research he developed optical films for LCD enhancement and in 2000 he started his work on new manufacturing technologies of LCDs for large area displays and electronic wallpaper. From 2003 to 2010 he was senior research fellow and vice president at the Philips Research Laboratories.

In 1996, he was appointed as part-time professor at the Eindhoven University covering research topics as liquid crystals, polymer waveguides, solar energy, organic semiconductors, nanolithography, soft lithography and polymer actuators for biomedical microfluidic systems. In 2010, he was appointed as fulltime professor in Eindhoven to chair the Department Functional Organic Materials and Devices with a research emphasis on clean technologies as energy harvesting, water treatment and healthcare. In 2015 he became staff member of the Institute for Complex Molecular Systems in Eindhoven and coordinates presently a program on responsive soft materials. In 2015 he co-founded the Institute of Device Integrated Responsive Materials, a joint initiative of South China Normal University and Eindhoven University of Technology.

Prof. Broer is member of the Royal Netherlands Academy of Arts and Sciences (KNAW) and received, among others, the SID Jan Rajchman Prize in 2014. In total, he has around 260 publications in peer reviewed journals and more than 120 US patents.

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How can we keep the Mars Rover clean?

Dirk J. Broer
Institute for Complex Molecular Systems
Department of Functional Organic Materials and Devices
Eindhoven University of Technology
Eindhoven. The Netherlands

Polymers that perform a programmed and reversible shape change have a wide application potential varying from micro-robotics to spacecrafts. A well-studied principle is based on a triggered and controlled change of the molecular order in liquid crystal polymer systems. We are utilizing similar techniques to change the topography of surfaces. This can be in the form of responsive cilia integrated in surfaces which can be utilized for transport of liquids or species. But it can also be a triggered change of the surface topography that affects the touch sensation and is of interest for haptic applications. As with the programmed shape changes, the underlying mechanism is a change of order parameter of the molecular ordered liquid crystal network coating. In addition to changes in molecular direction, volume is created originating from vibrating molecular entities in the polymer network which create dynamic molecular voids. This dynamic free volume leads to a temporary density decrease and the correlated volume increase which can be patterned and localized by an accurate control over the liquid crystal director. The triggers to actuate the coatings are temperature, light, pH, changes in environment or electrical fields. Bringing motion into coatings will open the route to completely new applications where coating actively will perform work or respond to changes in their environment.

As example, a coating will be shown that actively remove soil from its surface.

In addition, the coatings can be modified to secrete liquids upon request, for instance to lubricate, protect or clean. Also here an example will be shown of a coating that emits liquid, either by light or by an electrical field, that changes the adhesive properties of species applied on its surface.

Thursday, November 8, 2018 14:00
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Reactive mesogens: from display optics to complex soft robotic functions

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Since their development in the 80's of last century, reactive mesogens (RM's) form a versatile class of soft matter materials that have find their way to a wealth of applications. The frozen-in molecular order of the polymer networks that they form upon polymerization brought a new dimension into liquid crystal technologies. Initially developed for their use as low shrinkage, low thermal stress coatings, the RM's demonstrated their function especially in optical applications. The large, temperature-stable and adjustable birefringence was adopted by the display industry for many purposes, varying from viewing angle enhancement to optical-retarder based 3D imaging optics. Presently, advanced optical applications for augmented reality and astronomy lenses are drawing much attention as well their use to stabilize special liquid crystal effects for smart windows and dedicated display types.

The use of RM's for soft robotics applications is nowadays studied by many academic and industrial institutes. Triggered by heat, light or humidity the polymers change shape, surface structure or porosity. At Eindhoven University, we developed self-sustaining oscillators, cilia based micro-transport devices and haptic surfaces. Films deform from a flat to a complex, but pre-designed, shape with prospects to light-triggered origami and self-folding plastic elements. A completely new development relates to coatings that switch their surfaces from flat to corrugated with a preset topography. Or in a different design from dry to wet by controlled secretion of liquid. Properties that enable controlling properties as friction, grip, lubrication, stick, soil rejection, particle manipulation, etc.

The lecture will discuss our newest developments in responsive liquid crystal polymer materials, giving a preliminary view on the future of RM's with advanced applications in the fields of oscillatory films, smart coatings, soft robotics and haptics.

Friday, November 9, 2018 10:00
METU Department of Chemical Engineering Z-17