ERATO SEMINAR

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Going soft: From ultraflexible and stretchable electronics to soft robots and energy harvesting

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Date & Time: May 22nd (Wed), 2013, 13:30- 14:30

Place: Meeting Room 4(102C2), Engineering Bldg 2, The University of Tokyo

Abstract: In the talk I will give a brief review of our latest work in the diverse areas of macroelectronics, soft robots and energy harvesting, obtained by many co-operations within our university and with many research teams in leading universities worldwide.

Macroelectronics is a recent branch of electronics mainly driven by research on large area displays. Based on our initial work on large area position sensitive detection schemes with cellular polymers and organic photodiodes, we developed solutions to make any large area screen interactive, techniques currently commercialized by the spin-off company isiQiri.

Organic semiconductors are still an active area of research, where our contributions are mainly in the identification of highly unusual material systems. Hbonded analogues of tetra- and pentacene, epindolidione and quinacridone show large field effect mobilities and stable hole transport in air, questioning the necessity of strong intramolecular pi-conjugation for efficient charge transport. Epindolidione and quinacridone are better known as yellow and magenta charges in ink-jet printers.

Ultrathin and lightweight organic solar cells with high flexibility are over ten times thinner, lighter and more flexible than any other solar cell of any technology to date. They reversibly withstand extreme mechanical deformation and have unprecedented solar cell-specific weight, with potential applications in stretchable electronics, the latest frontier of research in macroelectronics. While solar cells deliver energy, energy must also be stored for stand alone stretch electronic systems. We have demonstrated two years ago the first ultrastretchable dry gel cell battery, able to withstand mechanical stretching up to 100 %. Ultrathin electronics with a total thickness of around 2 μm allows bending with a radius of 5 μm. Such electronic foils can be even crumpled without failure and may pave a way for imperceptible electronics.

Stretchable electronics relies on elastomers. When an electric field is applied to soft elastomers, the thickness decreases and the area expands. This simple and robust principle is used in soft robotic systems, and most recently also in energy harvesting of mechanical energy from human gait or ocean waves. In the final part of the talk I will highlight our contributions to this field, like voltage triggered area expansions of 1700 % in dielectric elastomer membranes, as well as tools for analyzing the efficiency of dielectric elastomers for the conversion of mechanical into electrical energy.

I hope the talk will show that soft materials developed from scientific curiosity to real world applications.

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Biography: Siegfried Bauer received the Master and Ph.D. degrees in physics from the Technical University in Karlsruhe in 1986 and 1990, respectively. In 1992 he joined the Heinrich Hertz Institute for Communication Engineering in Berlin, Germany. In 1996 he earned the Habilitation Degree from the University of Potsdam. In 1997 he became a Professor of Experimental Physics at the Johannes Kepler University Linz, Austria. Since 2002 he has been head of the Soft Matter Physics Department. Dr. Bauer's research is devoted to functional soft matter and its application to flexible and stretchable electronics and to energy harvesting. In 2012 Dr. Bauer was awarded with a European Research Council Advanced Investigators Grant.

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