MOLECULAR RECOGNITION IN CHEMOMECHANICAL POLYMERS : FROM AMINOACIDS , PEPTIDES, NUCLEOTIDES, AND GLUCOSE TO CHIRAL COMPOUNDS

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Molecular recognition of natural compounds is the basis of most biological functions, including the control of motions, vessel changes etc. New technologies use molecular recognition with synthetic host systems as basis for many applications. We will discuss how supramolecular complexes can be used as basis for new intelligent materials, such as artificial muscles/actuators, or as new drug delivery devices. The implementation of supramolecular binding sites into flexible polymers allows to translate **selective** molecular recognition events into large macroscopic motions. Uptake of effector compounds from the aqueous surrounding can lead to fully reversible size expansions of such polymer films by up to 2000% in volume, or to contractions of similar size.
Most of our hydrogels contain e.g. polyamines and lipophilic alkyl or aryl groups as host components, and show different expansions for a large variety of effectors. Most recently it has been shown, how such polymers can be used to release selectively drugs such as insulin as function of **glucose levels** in blood plasma. The dimension changes can dramatically depend on the presence or **two** effector compounds in the surrounding medium, either with negative or with positive cooperativity. The macroscopic dimension change occurs if two different effectors are present within a narrow concentration range, thus providing for the first time a chemically induced macroscopic logical AND gate. Selective interactions of the covalently attached supramolecular polyamine binding sites with transition metal ions have been shown to lead to dramatic macroscopic size changes by simultaneously added metal chelators, aminoacids and peptides. With chitosan-derived gels we have been able to translate for the first time **chiral recognition** into directly measurable macroscopic motions. An important, until now often overlooked possibility to enhance the sensitivity of the actuator volume changes is the downsizing of the polymer particles. Miniaturization of chemomechanical polymer particles holds much promise for both enhanced response sensitivity and velocity.

Selected papers from the Saarbrücken group:

" Molecular Recognition in a Supramolecular Polymer System Translated into Mechanical Motion "
Angew. Chem. Int. Ed. Engl. **2003,** *42* , 3544-3546.

"Large macroscopic size changes in chemomechanical polymers with binding sites for metal ions"
Chem. Commun. **2004/ ,** 100-101.

" Molecular Recognition in a Supramolecular Polymer System Translated into Mechanical Motion "
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"Large macroscopic size changes in chemomechanical polymers with binding sites for metal ions"
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“Sensitivity increase in molecular recognition by decrease of the sensing particle size and by increase of the receptor binding site – A case with chemomechanical polymers” *Chem. Commun.* **2004,** 2436 to 2437.

„Ternary Complexes for Large Motions of a Chemomechanical Polymer Induced by Metal Chelators, Aminoacids and Peptides“ *Tetrahedron Lett.* **2005,** *46*, 751-754.

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“Dimension Changes in a Chemomechanical Polymer Containing Ethylenediamine and Alkyl Functions as Selective Recognition Units” *Eur. J. Org. Chem* **2006,** 677–692

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“Chemomechanical Polymers” In : „*Intelligent Materials,* M.Shahinpoor and H.-J.Schneider, Eds. *Royal Soc.Chem. , Cambridge UK*, **2007**.

“The direct translation of chiral recognition into mechanical motion” *Angew. Chem. Int. Ed.* **2007,**