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NANOTECHNOLOGY IN BIOMEDICINE

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1. INTRODUCTION

A brief overview of the impact of nanotechnology on biomedicine and life science will be given as well as examples where nanotechnology has benefited by borrowing concepts from nature.

The rest of the talk will focus on our recent work on the integration of molecular motors of mucle . (myosin and actin) with nanotechnology. Three aspects of our work will be considered: 1 The use of molecular motors for cargo-transportation in nanotechnology (lab-on-a-chip, factory on a chip); 2. The use of nanotechnology for fundamental studies of how the molecular motors work and 3. The development of highly miniaturized high-througput drug screening systems with molecular motors as intended drug targets.

2. RESULTS AND DISCUSSION

In the talk I will first describe the basic function of the actomyosin motors with focus on their involvement in cargo transportation in the living cell [1]. Methods (so called *in vitro* motility assays) that allow restitution of actin myosin motor function on a glass surface outside the living cell are then described followed by a description of our recent work [2-4] where we have modified the in vitro motility assays for production of ordered motion. In these studies we have used micro- and nanostructured surfaces and channels where the position and direction of movement produced by molecular motors is controlled. In this connection the usefulness of surface modifications *e.g.* various silanization procedures are considered with focus on the possibilities to promote and hinder molecular motility, respectively. Particularly we describe our latest test system [3] being both morphologically and chemically nanostructured giving us unsurpassed possibilities to perform functional studies as well as extremely good spatio-temporal control. In this connection I will consider the relevance of these studies to other areas of science and technology. Then a nanotechnological cargo transportation systems based on the actomyosin motor system [5] will be briefly described. I will also discuss the usefulness of molecular motors for lab-on-a-chip applications and the requirements for incorporating these motors in commercially viable devices (see further [1]). In this context the significant potential of the actomyosin motor system to overcome traditional limitations of micro- and nanofluidics is stressed. Finally, I will describe prototype nanostructures for functional studies and drug-screening activities with the molecular motors in focus.

In the fundamental functional studies the purpose is to use nanotechnology to allow reconstruction of the ordered arrangement of actin and myosin existing in a living muscle cell. This will allow us to deduce new information that will contribute to elucidating the high mechanical efficiency of the muscle motor.

In the development of drug screening systems we work towards novel concepts with unprecedented miniaturization that will limit the amount of chemicals, animal material and space required in the early phases of drug screening. Such a development has significant economical, environmental and ethical implications. In our work we will focus the drug-screening efforts on molecular motors as intended drug targets. This is relevant since molecular motors underlie the ability of cancer cells to disseminate through metastasis and the ability to malaria parasites to invade cells.

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