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Active and Passive Electronics for Smart Implants

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Electronics of tomorrow will be flexible and will form a seamless link between soft, living beings and the digital world. The unique possibility to adjust the shape of the devices offered by this alternative formulation of the electronics provides vast advantages over the conventional rigid devices particularly in medicine and consumer electronics. There is already a remarkable number of available flexible devices starting from interconnects, sensing elements towards complex platforms consisting of communication and diagnostic components [1-4].

We developed flexible [5,6], printable [7,8], stretchable [9,10] and even imperceptible [11] large area passive electronic components with the specific focus on magnetosensitive elements, which were completely missing in the family of flexible electronics, e.g. for smart skin applications. On the other hand, we realized self-assembled compact tubular microchannels based on strain engineering [12] with integrated passive sensory elements [13-15] and communication antenna devices [16] for on-chip and bio-medical applications, e.g. smart implants [17,18].

Combining these two research directions carried out at different length scales into a single truly interdisciplinary topic opens up the novel field of smart biomimetics [18]. In this respect, we demonstrated mechanically and electrically active compact biomimetic microelectronics, which can serve as a base for realization of novel regenerative neuronal cuff implants with unmatched functionalities. The biomimetic microelectronics can mechanically adapt to and impact the environment possessing the possibility to assess, adopt and communicate the environmental changes and even stimulate the environment electrically.

In my talk, these recent developments will be covered.

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