

Small-scale Medical Robots down to Cell Size inside Our Body

Prof. Dr. Metin Sitti

Wireless small-scale medical robots have the unique capability of navigating, operating and staying inside hard-to-reach, tight, risky and deep sites inside our body. This talk reports our recent milli- and microscale wireless miniature medical robots down to cell size that could achieve various minimally invasive medical functions, such as targeted active drug delivery, neural stimulation, clot opening, liquid biopsy, biofluid pumping, cauterization, and hyperthermia. Due to miniaturization limitations on on-board actuation, powering, sensing, computing and communication, new materials and methods need to be introduced in creating and controlling such robots. Moreover, they need to be tracked under medical imaging modalities, such as ultrasound, fluoroscopy, photoacoustic imaging, and MRI, for their precise and safe operation. 3D microprinting and assembly-based fabrication methods and biocompatible and multifunctional soft composites with embedded micro/nanomaterials are proposed to create novel medical milli/microrobots. Soft-bodied medical miniature robot designs enable active shape programming-based adaptive, multimodal and multifunctional navigation and functions, and safe operation. External physical forces, such as magnetic fields, acoustic waves and light, and physical or chemical (e.g., catalytic) interactions with the operation medium are used to actuate and steer such miniature robots wirelessly as a single robot or robot collectives. These robots are aimed to save lives of more patients by curing diseases not possible or hard to cure and decrease the side effects and invasiveness of disease treatments drastically.