An implantable microfluidic antenna for biomedical sensing

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Development of human-body implantable antenna potentially enables a variety of biomedical applications, including real-time monitoring patient's physiological parameters (e.g. cardiac rate), sensing growth of tumor or long period evaluation of cosmetic surgery. To guarantee a safety of the implantation, the device should fulfill essential requirements, such as compactness, light weight, flexibility and biocompatibility. However, most of the current antenna technologies use rigid metals as electrically conductive elements, and they are also un-biocompatible with human body and may result in serious rejection reactions, which hamper its application in implantation. To address this challenge, we herein present an implantable dipole antenna using polydimethylsiloxane (PDMS) elastomer and gallium–indium eutectic as materials. PDMS is flexible and biocompatible, and it's used to fabricate microchannel by soft lithography and rapid prototyping method; while gallium–indium eutectic is a liquid metal at room temperature, and it's injected and sealed in the microchannel as electrically conductive element of the antenna. We found that the antennas have very good mechanical properties, and it can bear deformation induced by stretching and bending and twisting and restore its original state after removing applied stress. To optimize the design of fluidic antennas, different sizes and shapes of the antennas were fabricated and characterized in artificial human tissues in terms of working frequency band and reflection coefficient. Theoretical analysis and numerical simulations were also carried out and compared with experimental results, indicating a good consistency. We believe these microfluidic antennas open up a new road for in-vivo biomedical sensing.