A Small Implantable Dual Band Biocompatible Antenna for Medical Wireless Telemetry Applications

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Small antennas are absolutely essential for implantable medical telemetry systems since they dictate the overall size of the system. Earlier, we designed a miniaturized implantable antenna based on the leaky wave properties of the wave travelling along the interface (which happens in case of a slot along the interface) between two different dielectric media. The leaky wave is radiated in the medium with higher wave number. The property is extremely useful for implantable antennas since the dielectric properties of biological tissues are extremely high. The designed antenna had dimensions of 10mm x 12 mm x 1mm and was printed on FR4 substrate. This antenna is not biocompatible and it can be made so by coating the antenna with biocompatible materials like silica (ε_r =3.8). Coating the antenna with permittivity less than FR4 does not produce leaky waves and hence no radiation. This problem can be averted by coating the antenna with a higher permittivity biocompatible material. The additional layer complicates the antenna design in addition to increasing the size of the implant.

In this work, we propose a very small implantable antenna made of biocompatible materials. The substrate is 1 mm alumina (Al_2O_3) and the metallic coating is made of silver palladium alloy (both being biocompatible). The size of the designed dual band antenna is 4 mm x 4mm x 1mm. The design is based on two parallel slot each resonant at the respective frequencies. The slots are excited by a coplanar feed. The designed antenna operates in the entire Medical device radio communications service (MedRadio) band and industrial, scientific, and medical band (ISM) (2.4- 2.48 GHz). The percentage bandwidth/gain at lower and higher bands is 22%/-35dB and 35% /-22dB respectively. The antenna can be designed with and without a ground plane depending upon the needs of the applications and fabrication technology used. For measurement purpose, skin mimicking gels are used to emulate electric properties of the skin. The measured antenna show excellent performance in terms of return loss and bandwidth. To the best of our knowledge, the designed antenna is the smallest implantable antenna ever reported in literature.