Extended summary

HARDWARE DEVELOPMENT OF A NEW BIOMEDICAL DEVICE FOR MEDICAL RESEARCH AGAINST EPILEPSY

Curriculum: mechanical engineering and management

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Abstract.

Use of polymers in medical application is one of the most active field in plastic research. Nowaday, there are different example of use of polymers in implantable devices as dental, surgical and cranial prostheses, for long term period also, in which materials as steel and ceramic have been substituted by polymers.
The thesis work deals with the development of the hardware for a new wireless system used in medical research against epilepsy, realized in cooperation with A TLC s.r.l. and Plast 2000 s.r.l.

The system is composed by a small box and a cage. The box is implanted into the animal body, and contains electronic devices that send signals to an external control system. Cage instead is designed to accommodate the animal in which the box is implanted and some electronic device necessary to communicate and work with the electronic device into the box. Moreover, to allow communication between box and external control system, cage have to be realized with a material electrically insulated. For both cases, the steps followed in the development are described.
About the box, the study started with material research and choice. It has to be ISO 10993 compliant for long term implantable devices, coupled with good mechanical properties to bear mechanical stress previewed by production cycle, and technological properties to be

easily worked by machine tools (for prototypes realization) and to be easily molded by injection molding (for larger productions).
Following steps were optical material properties determination, in particular transparency of PEEK to visible and infrared light as function of material thickness, and selection of glue for bonding and sealing of the two parts composing the box. At the same time, mechanical performances of the system were determined using FEM. Numerical results have been checked by experimental laboratory tests. Development ends with a feasibility study for project industrialization. Molds for injection molding of the box have been studied and designed considering constraints as press dimensions, rheological properties of material, and economic aspects regarding material handling due to the high cost of PEEK.
Cage instead is an example of metal replacement for big dimensions structure. In this case, use of PA allowed to realize a non conductive structure, crucial for the application, with the same performance of steel in terms of mechanical resistance and weight. Moreover, the electronic devices have been inserted into the structure and have been insulated by the water, to make the system suitable for sterilization and washing operations.

Keywords. PEEK, injection molding, biocompatible materials, PA.

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