The Use of Advanced Microelectronic Packaging Techniques to Miniaturize Implantable Neuro Stimulators

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Abstract

Implantable Neurostimulators are being used to treat a number of Modalities, such as treatment for Chronic Pain using the Spinal Cord Stimulation (SCS) approach, Deep Brain Stimulation (DBS) for epilepsy and Parkinson's disease, and in limited cases Urinary Incontinence.

One of the barriers for Neuromodulation market growth is patient acceptance for an implant. Smaller unobtrusive and "invisible" devices will lend to an increased acceptance thus more implantations. Smaller is also viewed as less intimidating to the patient. On the other hand, practitioners such as Doctors and care givers perceive smaller devices as being more advanced technically, thus smaller devices are expected to increase adoption amongst healthcare professionals. Practitioners also want the best for their patients, so they would be more apt to prescribe a smaller device than a larger one.

Further, it is also desirable to have the implant sense the onset of potential attack, analyze signals and assume autonomous actions to counteract effect; this is referred to as "Closed loop Stimulation".

This presentation will review packaging techniques for several neurostimulation devices and discuss a revolutionary neurostimulation implant used in a novel approach for the treatment of Parkinson's disease which employs closed loop stimulation. The methods used in the design approach to determine the optimum way to achieve the size requirements will be discussed as will be the final microelectronic manufacturing techniques employed and why they were chosen.

Adding the closed loop feature and reducing the overall size of the implant required implementation of a multilayered flex board with tight line spacing requirements and die attach for the sensing circuit and microcontroller which are in bare die form. Attachment techniques such as gold ball wire bonding and various types of Flip chip attachment were considered; therefore, the presentation will discuss how the final manufacturing techniques and form factor were arrived at that ensured a robust design and long term reliability.