GRAFTING LUBRICIOUS AND FIBROSIS-RESISTANT THIN FILMS TO COCHLEAR IMPLANTS BY PHOTOPOLYMERIZATION

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Cochlear implants (CIs) restore auditory perception to patients with significant hearing loss. However, tissue fibrotic responses in the cochlea following implantation of an electrode array can reduce the effectiveness of the CIs and may contribute to loss of any residual hearing. This tissue fibrosis results, at least in part, from a foreign body response to the presence of foreign biomaterials in the cochlea. We have developed a photgraftable zwitterionic thin film that has shown promise in preventing the fibrotic response in subcutaneous models. However, these thin films are difficult to photograft to curved surfaces of CI electrode arrays as keeping precursor solution in place for photografting is quite challenging. This work describes methods that show significant potential to photograft zwitterionic thin films onto CI electrode arrays.

The thin film photografting process is facilitated by an outer sleeve of polydimethylsiloxane (PDMS) which uniformly distributes the prepolymer solution by capillary action over the electrode array. To counter the resistance of the hydrophilic solution to capillary action over hydrophobic surfaces, we introduce 0.8% of a PDMS-polyethylene glycol surfactant. The thin film is characterized by scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS). The SEM-EDS reveals a uniform thin film by detection of surface atomic sulfur which is present in the thin film formulation but absent on the CI surface. The thin film is further characterized by epifluorescent microscopy in its native hydrated condition by fluorescein in water. The fluorescein illuminates a thin (<50 micrometer) uniform hydrogel across the entire target surface.

Thin films that prevent the foreign body response can be photografted onto complex curved implant surfaces by dispersing and UV polymerizing a surfactant-doped prepolymer solution over the desired surface by aid of a UV-transparent outer sleeve. These thin films have been applied to both human and mouse cochlear implant electrode arrays successfully.

These thin films have the potential to dramatically reduce the loss of residual hearing associated with cochlear implants and to increase device longevity.