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Variation in Performance of Platinum Electrodes with Size and Surface Roughness

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Platinum (Pt) has been extensively used in medical electrodes and is proposed as a candidate for stimulation sites in retinal neuroprostheses due to its relative inertness and stability in biological environments. However, as implantable therapeutic devices are created with increasingly smaller dimensions, it is necessary to ensure that electrode properties are optimised. In this study, we present the variation in Pt electrode performance, which occurs as a result of reducing the electrode size. Additionally, the feasibility of laser roughening these electrodes is considered with respect to stability under chronic stimulation. It is shown that as the electrode diameter is decreased, the charge storage capacity (CSC) per unit area is increased twofold. Additionally, the frequency-dependent impedance per unit area decreases, resulting in an increase in the charge injection limit of up to 3.4 times in the biological environment. Finally, the stability of laser-roughened electrodes is demonstrated by continuous biphasic stimulation for more than 1 billion pulses at levels consistent with the activation of the neural retina.

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