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Electrocatalytic on-site oxygenation for transplanted cell-based-therapies

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Abstract:

Implantable cell therapies and tissue transplants require sufficient oxygen supply to function and are limited by a delay or lack of vascularization from the transplant host. Previous exogenous oxygenation strategies have been bulky and had limited oxygen production or regulation. Here, we show an electrocatalytic approach that enables bioelectronic control of oxygen generation in complex cellular environments to sustain engineered cell viability and therapy under hypoxic stress and at high cell densities. We find that nanostructured sputtered iridium oxide serves as an ideal catalyst for oxygen evolution reaction at neutral pH. We demonstrate that this approach exhibits a lower oxygenation onset and selective oxygen production without evolution of toxic byproducts. We show that this electrocatalytic on site oxygenator can sustain high cell loadings (>60k cells/mm3) in hypoxic conditions in vitro and in vivo. Our results showcase that exogenous oxygen production devices can be readily integrated into bioelectronic platforms, enabling high cell loadings in smaller devices with broad applicability.

Keywords: implantable cell therapies, oxygen production, bioelectronic platform, hypoxic stress, iridium oxide, electrocatalytic on site oxygenation