

Therapeutic Protein Delivery for Bone Regeneration from Ti Implants Coated with Graphene Oxides

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The therapeutic efficacy of drugs often depends on the drug delivery carrier. Here, we demonstrate that graphene oxides (GO) are efficient carriers for delivery of therapeutic proteins. Titanium (Ti) substrates were coated with GO through layer-by-layer assembly of positively (GO-NH_3^+) and negatively (GO-COO^-) charged GO sheets. The GO coating on Ti substrate enabled loading of large doses and the sustained release of BMP-2 with preservation of the structure and bioactivity of the drug. The extent of in vitro osteogenic differentiation of human bone marrow-derived mesenchymal stem cells was higher when they were cultured on Ti/GO- carrying BMP-2 than when they were cultured on Ti with BMP-2. Eight weeks after implantation in mouse models of calvarial defects, the Ti/GO-/BMP-2 implants showed more robust new bone formation. Therefore, GO is an effective carrier for the controlled delivery of therapeutic proteins, such as BMP-2, which promotes osteointegration of orthopedic or dental Ti implants.