Gold-graphene modified titania nanotubes as electrocatalysts for borohydride oxidation

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Fuel cells are actively investigated as an attractive alternative energy sources for cleaner power generations. Recently, graphene as catalyst support has incurred intense interest in fuel cell applications due to its unique, outstanding physicochemical properties, such as an extremely high specific surface area (2600 m^2g^{-1}), a superior electronic conductivity, a high surface to volume ratio and a high stability (1-5). The combination of metal nanoparticles and graphene opens up new possibilities for design of the next generation catalysts.

This work is focused on the preparation of gold-graphene modified titanium dioxide nanotube arrays (denoted as Au-GR/TiO_2-NTs) as electrocatalysts for the oxidation of borohydride in an alkaline medium. The graphene film was formed on the surface of titania nanotubes arrays through in situ electrochemical reduction of a graphene oxide dispersion by means of cyclic voltammetry (6). Gold particles were deposited on the GR/TiO_2-NTs surface using the chemical and electrochemical methods. The morphology and composition of the prepared catalysts were identified using field emission scanning electron microscopy and energy dispersive X-ray spectroscopy. The Au-GR/TiO_2-NTs catalysts with different gold and graphene loadings were prepared and their properties were compared. The electrocatalytic activity of the fabricated catalysts towards the oxidation of borohydride was investigated by means of cyclic voltammetry and chronoamperometry.

It was found that the gold-graphene modified titanium dioxide nanotube arrays (Au-GR/TiO_2-NTs) exhibited an enhanced electrocatalytic activity towards the anodic oxidation of borohydride comparing with unmodified TiO_2-NTs and that modified with Au nanoparticles (Au/TiO_2-NTs).

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