Graphene-Based Nanocomposites as Catalyst Support in High Temperature PEM Fuel Cells

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Abstract

Carbon corrosion as one of the different catalyst degradation paths leads to limited lifetimes of fuel cells.[1, 2] Especially at the cathode side harsh conditions for the support materials with high variable potentials exist. In our recent work, we investigate nanocomposites of reduced graphene oxide (rGO) and indium tin oxide (ITO) as durable cathode support for platinum in high temperature proton exchange membrane fuel cells (HT-PEMFCs). ITO has already confirmed a good durability in the presence of high cycled potentials,[3] and the application of graphene-based carbon in low temperature PEMFCs has resulted in higher stabilities than conventional carbon black.[4] The hybrid structure serves for Pt nanoparticle stabilisation at the interface between ITO and rGO and can prevent rGO restacking and corrosion.[5]

The ITO-rGO nanocomposite as well as the final Pt/ITO-rGO catalyst is investigated by the use of scanning as well as transmission electron microscopy, EDS, XRD and other techniques. Particularly the precipitation of ITO nanoparticles is studied intensively by variation of synthesis parameters. Moreover, the same polyol method for platinum deposition is used to prepare reference materials, platinum on carbon black (C) and on multiwalled carbon nanotubes (MWCNT). The comparison shows the most narrow size distribution in the case of Pt nanoparticles on ITO-rGO, traced back to a homogeneous particle nucleation and growth without larger agglomeration occurrence. TEM images in Figure 1 show the successful deposition of platinum nanoparticles on ITO-rGO. The high dispersion and the mean particle size of 2.2 nm represent good conditions for application as electrocatalyst for the oxygen reduction reaction in fuel cells.

References

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Figures

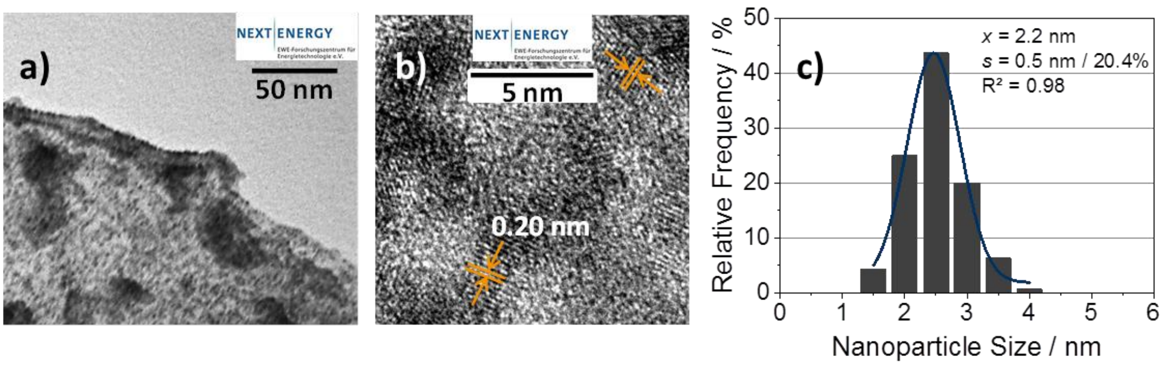

Figure 1 (a) TEM image, (b) HR-TEM image with Pt lattice planes and (c) size distribution of Pt on ITO-rGO.