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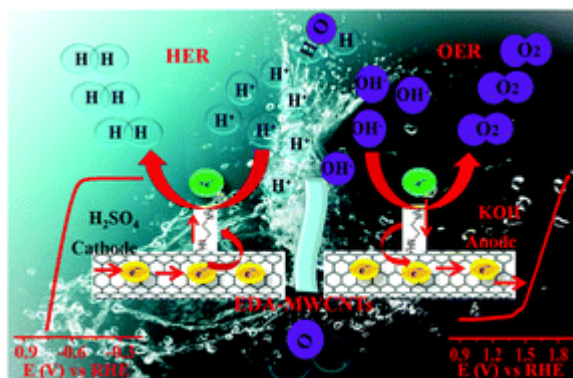
Amine-functionalized multi-walled carbon nanotubes (EDA-MWCNTs) for electrochemical water splitting reactions †

[Shankar S. Narwade](#),^a [Shivsharan M. Mali](#)^a and [Bhaskar R. Sathe](#) ^{*a}[Author affiliations](#)

Abstract

Herein, this study presents the highly efficient and inexpensive metal-free multifunctional electrocatalyst demonstrated for both hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) effectively for all pH. This current study also presents the *in situ* decoration of ethylenediamine (EDA) on acid-functionalized multi-walled carbon nanotubes (O-MWCNTs). Moreover, an ethylene diamine is known to form a stable nitrogen source to make nitrogen rich MWCNTs as a metal-free electrocatalytic system. Those as-synthesised nanomaterials were characterised *via* scanning electron microscopy (SEM), high resolution-transmission electron microscopy (HRTEM), Fourier-transform infrared (FT-IR), Raman spectroscopy, X-ray diffraction (XRD) and Brunauer–Emmett–Teller (BET) surface area analysis, which suggested the presence of N-containing active sites/defects in the lattice of the nanotubes. It is of great interest to the scientific community and still an impressive challenge; H₂ is a perfect candidate for the replacement of fossil fuels in the upcoming era due to the zero emission of carbon dioxide (CO₂) species during its combustion. O-MWCNTs and EDA-MWCNTs nanomaterials exhibit OER with ultra-small overpotentials of 0.27 V and 0.19 V at 10 mA cm⁻², respectively, having lower Tafel slopes of 49 and 40 mV dec⁻¹, respectively, in 0.5 M KOH. Moreover, the HER exhibits lower Tafel slopes of O-MWCNTs and EDA-MWCNTs 90 and 75 mV dec⁻¹, respectively, in 0.5

M H_2SO_4 . These efforts further demonstrate the high potential of the as-synthesized nanocatalyst towards hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). This metal-free electrocatalyst offers a novel, efficient, highly stable, environmentally friendly and inexpensive process for its fabrication. The catalytic activity exhibits that the ethylene diamine decorated on a multi-walled carbon nanotube EDA-MWCNTs composite could be an encouraging electrocatalyst towards HER and OER from their supportive interfaces.

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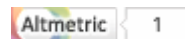


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