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Coatings of metal bipolar plates for PEM fuel cells and electrolyzers with high durability performance

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Proton Exchange Membrane (PEM) fuel cells and electrolyzers are in full development for automotive and industrial applications. Due to volume restrictions the classical graphite bipolar plate loses against a Titanium or Stainless Steel bipolar plate. Key is to keep a low Interface Contact Electrical Resistance and to avoid corrosion. The corrosion of metal in the PEM electrolytic environment of acidic character is one of the main challenges, since it decreases the efficiency and shortens the lifetime of the whole stack. The root causes are metal ions out-diffusion poisoning the catalyst and electrolyte, and non-conductive oxides formation increasing the electrical resistance. The problems outlined above are being overcome or minimized by applying corrosion-resistant and simultaneously electrically conductive coatings.
This work extensively investigates the electrochemical and electrical properties of DOT™ and metal-doped ta-C coatings. The cornerstone of DOT™ coating is thermal spraying of noble metal droplets forming the electrical contact points and simultaneously the corrosion-resistant surface oxide layer of the base metal or metal interlayer. Both coatings meet the U.S. Department of Energy technical targets for PEM fuel cell and electrolyzer components by exhibiting very low values of interfacial contact resistances < 10 $m\Omega \cdot cm^2$ and corrosion currents < 1 $\mu A/cm^2$ in simulated PEM environment.

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