Directly grown and vertically aligned carbon nanotubes as diffusion layers to enhance fuel cells performances

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In proton exchange membrane fuel cells, the micro-porous layer (MPL) of the gas diffusion layer (GDL) has been developed to ensure better gas transport and water management, and thus enhanced the cell performances and stability. Carbon nanotubes (CNTs) interest as a MPL or as catalyst support has already been demonstrated in several works [Kannan (2009); Tang (2011); Xie (2015)]. In this work, a layer made of vertically aligned CNTs was grown in-situ on the fiber of a gas diffusion media (GDM) by a hot filaments assisted chemical vapor deposition (HFCVD). The obtained structure strictly differs from conventional MPLs (figure 1). Functional properties of the GDL with CNTs were characterized with SEM imaging, contact angle and electrical conductivity measurements. 10-25 µm-long carbon nanotubes with a diameter ranging between 7-10nm were obtained. Electrochemical characterizations were conducted, both in wet and dry conditions, in a differential single cell. Several configurations were studied: GDL with CNTs on the anode, on the cathode, and on both sides. Several CNTs configurations on GDMs were also tested (*CEA patent pending*). CNTs as a MPL gives better performances (10% in dry conditions, 25% in wet conditions) than commercial MPLs.

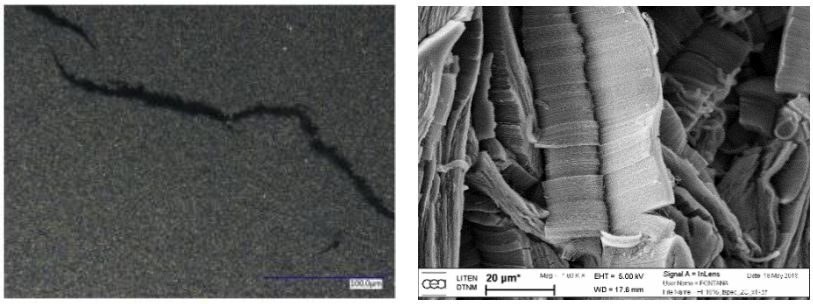

Figure 1: (left) SEM imaging of a commercial "MPL of 28BC (magnification 1000x)" from [Göbel, Journal of Power Sources, 2017] and (right) SEM imaging (x1k) of the surface of a GDL with CNT forest.

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