Power Engineering 2018- Correlation between physicochemical properties and blending time for sepiolite and halloysite inside Nafion matrix of proton exchange membrane used in fuel cell - Sahng Hyuck Woo - MINES ParisTech

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Abstract

Nafion is selected as a standard material in proton exchange membrane fuel cell (PEMFC) application to prepare perfluorosulfonic acid (PFSA) membranes due to its physicochemical properties such as chemical stability, good mechanical stability, and proton conductivity. However, Nafion membrane shows reduced properties above 80°C and at low relative humidity. Hence, sepiolite nanofiber (SEP) and halloysite nanotubes (HNT) are proposed to be used as a nanoclay filler within membrane to overcome such limitations. This study introduces the relationship between physicochemical properties and blending time for SEP and HNT inside Nafion matrix. The blending time impacts the homogeneity of the composite which is directly related with the performance. The homogeneity was checked through chemical analysis of silicon (Si) and fluorine (F) contents across the membrane (see Figs. 2 and 3). The shorter the blending time, the better the homogeneity. In the study, water uptake and thickness swelling of composite membranes displayed improved values compared with those of pristine Nafion membrane. Whatever the composite, as a general rule, the shorter the blending time the better the performance. This indicates that Nafion/SEP and Nafion/HNT dispersions blending for short time can surprisingly form more homogenous composite membranes resulting in decreased swelling.

Proton-exchange membrane fuel cells (PEMFC), otherwise called polymer electrolyte layer (PEM) power devices , are a sort of power device being grown chiefly for transport applications, just as for fixed energy unit applications and compact energy component applications. Their distinctive highlights incorporate lower temperature/pressure ranges (50 to 100 °C) and an exceptional proton-leading polymer electrolyte film. PEMFCs produce power and work on the contrary standard to PEM electrolysis, which devours power. They are a main contender to supplant the maturing basic energy component innovation, which was utilized in the Space Shuttle.

Two distinctive nanoclay minerals were joined with nanophase anatase TiO2 for the union of mud based nanocomposites for improved photocatalytic properties. Another Halloysite (Hal) + Sepiolite (S) - TiO_2 ternary nanocomposite was readied utilizing halloysite from Utah, USA and an as of late found sepiolite from Greece. Three nanocomposites were combined with Hal-TiO_2, S-TiO_2 and [Hal+S] to TiO_2. Accordingly, TiO2 particles (anatase) were homogeneously saved and scattered on the mud surfaces. Stage creation, molecule morphology and physical properties of these nanocomposites were described by XRD, ATR-FTIR, FE-SEM, DRS-UV–Vis and N2-sorption/desorption isotherms at 77 K. The photocatalytic action of the earth mineral-TiO_2 nanocomposites was analyzed in the disintegration of paracetamol and antibiotic medication anti-infection agents just as color Rhodamine-B. The nanocomposites showed higher photocatalytic action under UV light for the deterioration of the focused on poisons than the benchmark in the field, for example TiO_2-P25 photocatalyst.

Proton-leading blended network layers (PC-MMMs) have gotten impressive enthusiasm as promising materials that join the properties of, and make synergism from connections among, polymeric and inorganic parts. The PC-MMM show better attributes looked at than singular particle directing polymeric layers or detached electrolyte inorganic movies. Late headways in material planning have upgraded the capacity to structure PC-MMMs with determined properties. This basic audit talks about the advancement of the improvement of PC-MMMs, with exceptional spotlight on PC-MMMs dependent on developing materials, for example, permeable materials, metal natural structures (MOFs), carbon nanotubes (CNTs) and graphene oxides (GOs). Significant difficulties confronting PC-MMMs and systems taken to conquer those difficulties and future points of view are talked about.

Nafion®/Laponite nanocomposite layers for proton trade film power devices (PEMFC) were examined. Nanocomposite films were set up by a reworking method utilizing a Nafion® arrangement blended in with Laponite particles containing sulfonic corrosive gatherings clung to its surface. The surface change of the mud particles happens by means of plasma enactment. In the first place, the impact of temperature and relative mugginess on the proton conduction of the nanocomposite layers was examined and contrasted with the business Nafion® reference. It created the impression that the proton conductivity of the nanocomposite film is higher than that of the business Nafion® for all the temperature ranges contemplated (20–95°C) with an increasingly noteworthy distinction at low relative moistness. At that point, the

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desorption active of the water content was assessed at various temperature levels for the nanocomposite and business films. All outcomes show that the expansion of the inorganic mixes to Nafion® improves the water maintenance of the layer. At long last, the exhibition of the film cathode gathering (MEA) utilizing the nanocomposite layer was assessed by a power device test under various working conditions. The outcomes got show that the presentation of the MEA utilizing the nanocomposite film is better than the one of a business Nafion® layer, with a progressively significant contrast at high working temperatures.