ABSTRACT

As the fossil fuels are depleted rapidly, and the byproducts of fossil fuels are responsible for polluted environment, it becomes a necessity to develop an eco-friendly and renewable energy source. To overcome the problem of air pollution by the fossil fuel and due to energy requirement, our energy dependence on renewable energy sources should be high. Hydrogen has been widely deliberated as an attractive energy carrier with high efficiency for developing an environmental friendly and cost-effective sustainable energy system. However, besides the hydrogen energy, the main issue with other energy sources is energy density and area dependency.

Fuel cell is that unit, which is used to convert hydrogen in the other form of energy. The advantage with the H2 fuel cell has water, the only byproduct obtained after the energy generation. But the primary requirement for lifetime and efficiency of the fuel cell is the purified H2 from the impurities or separated H2 from other gases. So the separation/purification of the H2 is the solution for a new renewable energy source, prevent the environment from global warming as well as useful for controlling the air pollution.

The primary aim of our research work is to find out the eco-friendly technology through which we can separate/purify hydrogen. There are many types of method or process, which are used to separate/purify the hydrogen gas from the mixture of other gases. Moreover, membrane-based technology for the H2 separation/purification has attracted considerable response due to inherent benefits over other separation methods. The membrane-based separation process is not only cost-effective but also environmentally friendly as well.

Membrane-based gas separation, suffer from a problem in the form of trade-off relationship between selectivity and permeability. So, the control over selectivity and permeability of the gases is the main goal for the membrane-based gas separation. For the gas separation with the membrane is depends on two parameters; diffusion coefficient (D) and solubility coefficient (S). For gas separation application, we have used different types of porous polymeric membranes and functionalized these membranes to attach the gas sensitive nanoparticles. For the H2 selective membranes, we have synthesised and deposited palladium nanoparticles in the functionalized porous membranes.

Functionalization is an effective method for different functionalities for the membrane and subsequently desired nanomaterials can be incorporated into the polymer matrix. Initially, Polycarbonate (PC) with functionalized and non-functionalized MWCNTs composite membranes have been prepared. The alignment of the MWCNTs is controlled by high magnetic field. Pd nanoparticles were synthesised chemically and deposited on PC-MWCNTs composite membranes. In the obtained of permeability and selectivity data, significant improvement has been found with the use of functionalized MWCNTs and Pd nanoparticles.

If membranes will be functionalized by a specific functional group then it can improve the selectivity of hydrogen. We have functionalized porous PET membranes having pore diameter ~ 0.2 μm with carboxyl group. The effect of functionalization time on permeability and selectivity of hydrogen over other gases in PET membranes have been observed. Functionalized PET membranes were also used for the H2 separation application with 6 hours attachment of the Pd nanoparticles. Functionalization the specific group and attachment of Pd nanoparticles enhanced the H2 permeability as well as selectivity.

Further, to functionalized porous PC membranes, we have used a reliable and low-cost UV irradiation method with the fixed time difference. To enhance hydrogen selectivity, palladium nanoparticles have deposited into the pores as well as on the surface membranes. We have also use binder polyvinylpyrrolidone (PVP), for the palladium nanoparticles to improve the hydrogen selectivity over other gases. Due to the functionalization and maximum attachment of palladium nanoparticles, these membranes have high permeability as well as selectivity of hydrogen. Significant results, easy fabrication process and low cost of these membranes gives an opportunity to use for commercial use.