The design and fabrication of a 3D printed electrolyzer with membrane-less technology for green H_2 production

Niyamat Ullah khan, Milan Kumar

Abstract

Hydrogen production through water splitting is a popular technology. The reaction takes place in an electrolyzer unit. There are different types of electrolyzers available, including proton exchange membrane (PEM), anion exchange membrane (AEM), alkaline, and solid oxide. Although PEM is a widely used commercial electrolyzer, it is very sensitive, not very durable, and has a high cost due to the membrane. To eliminate the cost of the membrane, the concept of a membrane-less electrolysis technology was developed.

In this study, a new membrane-less electrolyzer design was proposed with flow through electrolyzer as shown in Figure 1. The design was manufactured with the help of 3D printing technology with acrylonitrile butadiene styrene (ABS) polymer material that is more stable in basic medium. To increase the conductivity of water 4M KOH solution was provided for electrolysis. In this design, electrodes were put at an angle of 30° with each other. The generated hydrogen and oxygen gas were separated from each other with the effect of the flow of water between the electrodes. The tapered inlet is provided to maintain the proper laminar flow through the inlet. In the middle of the electrolyzer, a divider is also provided for separating the generated hydrogen and oxygen gas. The Ni mesh with 80 grit size was used at a place of electrodes. The purity of the generated gas was measured in gas chromatography instrument H_2 purity of about 99.85 % was achieved by using Ni mesh as an electrode at N.T.P.

Keywords- Electrolyzer, membrane, Nickel mesh, 3D printing.

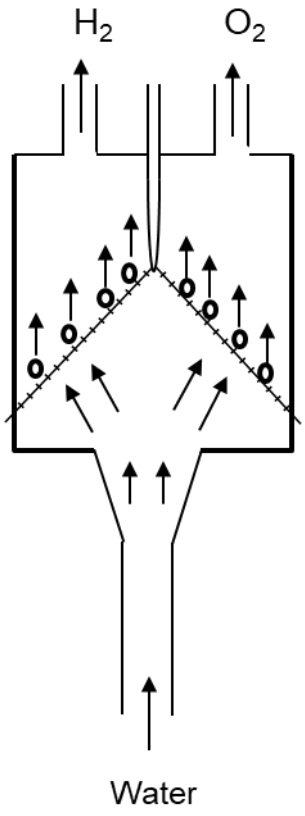

Figure 1 The Schematics diagram of membrane-less electrolyzer