The continuous increase in energy consumption and the scarcity of conventional fuels have caused serious concerns all over the world. Therefore, the development of clean energy production technology has become the main research priority around the world. Universalization of advanced energy conversion technologies would be very beneficial such as metal-air rechargeable batteries, fuel cells, and water splitting devices with the synthesis of suitable catalytic materials that can carry out electrochemical processes including the hydrogen evolution reaction. The synthesis of cost-effective electrocatalysts, with high stability, resistance to corrosion in any environment, and suitable composition, microstructure, and special surface is a big challenge in the electrocatalysts industry. Due to the scarcity and high price of common noble metal electrocatalysts based on platinum, palladium, iridium, gold, silver, and ruthenium, as a substitute, various transition metals have been used to produce advanced electrocatalytic materials in order to improve the performance of the electrocatalytic property. Among the transition metals, nickel has emerged as one of the main and promising components due to its excellent oxidation-reduction properties in energy applications and the synergistic effect predicted to significantly change the surface properties of materials in order to be a suitable electrocatalyst. Meanwhile, nickel-based composites (nickel-molybdenum, nickel-graphene, nickel-molybdenum-graphene, etc.) have helped to improve the electrocatalytic performance of nickel. By using nickel compounds and using carbon materials, especially graphene oxide, the active sites are increased. By creating a porous morphology, high specific surface area and better electrocatalytic properties will be obtained. The aim of this research is to synthesize a nickel-based nanocomposite electrode to produce hydrogen as a clean and environmentally friendly fuel. For this purpose, graphene oxide is synthesized and reduced to hydrophilic graphene. By simultaneously using an electrolyte containing nickel and elements such as molybdenum along with hydrophilic graphene, a porous nickel-graphene nanocomposite coating is synthesized on two types of nickel foam and nickel sheet substrates by electrochemical deposition method. The electrocatalytic properties of nanocomposite electrodes are investigated. Due to the simultaneous synthesis of graphene oxide and nickel alloy, in addition to the high stability of the synthesized electrocatalyst, due to the creation of a high specific surface, it is expected to reach an additional potential close to that of platinum. It seems that the use of nickel-graphene based nanocomposite will improve the electrocatalytic property in the hydrogen release reaction from water. Also, the excellent surface properties of the nanocomposite electrode in the field of electron transfer and high corrosion resistance will improve the useful life of the electrode.