The current technology for CO₂ reduction is CO₂ capture and storage (CCS). An alternative technology is to capture CO₂ and convert it to chemicals by thermal catalysis. The technology is not appropriate to low concentration of CO₂ (<1%), such as CO₂ in air except it has to be driven by thermal energy mainly produced by fossil fuel combustion. The solar energy driven CO₂ conversion is an only technology without extra CO₂ emission (neutral carbon process) and very compatible with atmospheric CO₂ condition. Solar energy is most abundant in the world. However, it is difficult to store the produced electric energy in large quantities using the present technologies. Hereby there is still a real need to exploit other methods to easily convert and store solar energy alongside discovering new technologies to largely store electric energy. Photocatalysis, utilizing solar energy to drive chemical reactions over a photocatalyst, is a novel and advanced technology. Solar hydrogen production is an approach to convert solar energy to chemical energy hydrogen by means of photocatalysis. Alternatively, the photoreduction of CO₂ directly to a renewable fuel, such as methanol is another approach to convert and store solar energy in chemical bonds. Compared with hydrogen, methanol is a superior fuel due to 1) its higher energy density (1000 times higher than hydrogen per volume) and 2) easier storage and transportation.

Photocatalytic CO₂ conversion towards methanol mimics natural plant photosynthesis. Nature represents the blueprint for storing sunlight in the form of chemical fuels (such as sugars) by CO₂ conversion. The primary steps of natural photosynthesis involve the absorption of sunlight and its conversion into separated electron/hole pairs. The holes of this wireless current are then captured by the oxygen-evolving complex (OEC) to oxidize water to oxygen, which allows the electrons are captured by PSI to reduce NADP⁺ to NADPH (the reduced form of NADP⁺).

In this paper we will offer an overview of this emerging technology and its potential applications by using cheap inorganic photocatalyst instead of complex proteins/enzymes while the reduction product is methanol rather than NADPH.