Green Solar Fuels: Hydrogen and Ammonia

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In order to face the climate changes, the European Union has set three targets for 2030: (i) reducing greenhouse gas emissions (ii) increasing the share of renewable energy, and (iii) improving energy efficiency. Two of these targets require the development of suitable energy vectors, such as green solar fuels, able to mitigate the intrinsic unpredictable availability of renewable energy sources, and to provide a carbon free alternative to fossil fuels. In this talk two possible approaches will be presented. The large-scale implementation of solar hydrogen production requires an optimal combination of photovoltaic systems with suitably-designed electrochemical cells, possibly avoiding power electronics, to decrease costs. As a main result of the H2020 PECSYS project, we will show that the optimized connection of a state-of-the-art proton exchange membrane (PEM) electrolyzer to a bifacial silicon heterojunction solar module with three cells in series allows highly efficient solar hydrogen production, up to 13.5%. Despite the high achievable efficiency and high maturity level of the technology, however, green hydrogen production still remains an expensive process, with high pressure (700 bar) required for storage. Ammonia may be an interesting alternative. Not only it is essential to the global economy as a fertilizer feedstock and industrial chemical, but it is also a promising energy vector, with high energy volumetric density and, unlike hydrogen, ease of liquefaction for storage. However, the industrial production of ammonia is obtained through an energy intensive process, responsible for 1-2% of the total worldwide CO_2 emission. Alternative production of ammonia by electrochemistry and its use as a fuel are the target of the H2020 TELEGRAM project. The main challenges and the first results will be presented.