



**WORKSHOP ON NEW MATERIALS FOR RENEWABLE ENERGY
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NATURAL AND ARTIFICIAL PHOTOSYNTHESIS. BASIC CONCEPTS.

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ABSTRACT:

To exploit sunlight, Nature has developed in billions of years photosynthesis, a very complex process that has produced fossil fuels (coal, oil and gas) through an intricate net of chemical reactions. Fossil fuels are concentrated forms of energy that can be easily stored and transported. Since they are going to be exhausted and their use causes severe damages to human health and environment, scientists are now engaged to find the way of using sunlight for producing *clean* fuels. With this aim, scientists have carefully investigated the complex mechanism of natural photosynthesis and are now trying to create artificial photosynthetic processes much simpler than the natural one and capable of producing the simplest solar fuel: hydrogen from water splitting. Water splitting by sunlight, of course, is not a straightforward process, otherwise it would already happen in Nature. The electronic absorption spectrum of water, in fact, does not overlap the emission spectrum of the sun, so that direct water dissociation by sunlight cannot take place. This means that the water splitting reaction by sunlight must be sensitized by species absorbing visible light and capable of being involved in cycles in which the absorbed energy can be profitably used. Splitting liquid water with evolution of molecular oxygen and molecular hydrogen has a low energy thermodynamic threshold (1.23 eV) that in principle allows conversion of about 40% of the solar energy. Such a splitting water cycle, however, requires coupling between one-photon/one-electron photochemical processes with multi-electron processes that have to be mediated by catalysts. The most recent achievements in this field will be presented and discussed.