Photosynthesis has been seen in action for the first time, which could help researchers develop a new generation of fuels.

Photosynthesis splits molecules of water into oxygen, protons and electrons. For the first time in history, this process has been recorded in a series of images. Arizona State University researchers conducted the study.

Photosynthesis helps to maintain the atmosphere of the Earth today, and helped radically shape our planet in the distant past. When the Earth first formed, there was little oxygen in the atmosphere. Around 2.5 billion years ago, the first living organisms capable of splitting water in such a fashion, in order to extract energy. These species proliferated, soon filling the air with oxygen.
Researchers developing alternative energy sources are seeking ways to mimic this process, manufacturing eco-friendly fuels that could replace gasoline and diesel to drive motorized vehicles.

"A crucial problem facing our Center... is discovering an efficient, inexpensive catalyst for oxidizing water to oxygen gas, hydrogen ions and electrons. Photosynthetic organisms already know how to do this, and we need to know the details of how photosynthesis carries out the process using abundant manganese and calcium," Devens Gust of Arizona State University (ASU) said.

Traditional methods of observing photosynthesis involve using X-ray lasers to record instantaneous information on the process. This also destroys much of the mechanism needed to carry out production of oxygen. The team got around this problem by taking advantage of the world's most-powerful X-ray laser.

"Extremely fast... laser pulses record snapshots of the PSII crystals before they explode in the X-ray beam, a principle called 'diffraction before destruction,'" Petra Fromme, professor of chemistry and biochemistry at ASU, told the press.

During photosynthesis, tiny nanocrystals contain clusters of four manganese and one calcium atom. This is connected to a protein, lowering the energy needed to break oxygen free of water. In order to produce a single molecule of the gas, the process requires two water molecules and four flashes of light.

These structures were exposed to flashes from the power laser, which caused the metal cluster to elongate, creating enough room for a molecule of water to enter the system.

"This is a major step toward the goal of making a movie of the molecular machine responsible for photosynthesis, the process by which plants make the oxygen we breathe, from sunlight and water," John Spence, physics professor at ASU, explained in a press release.

Producing these images could help biologists and others better understand how the mechanism works. This data could be used in the production of a new generation of environmentally-friendly fuels.

Researchers detailed their study photographing photosynthesis in the journal Nature.