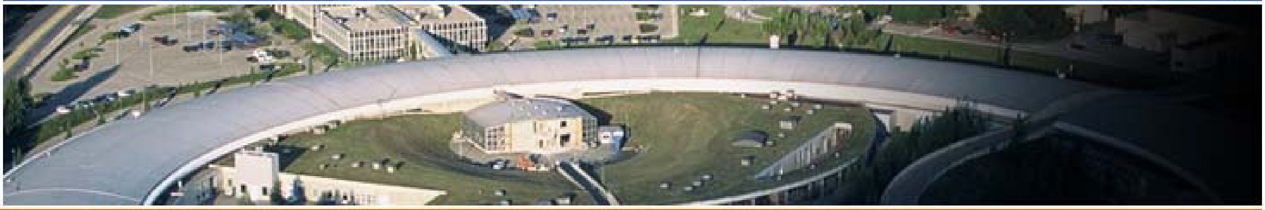

press releases

PRESS RELEASE: Plants reveal a secret and bring researchers nearer a cleaner future

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## Researchers from Freie Universität Berlin identify a new step in photosynthesis

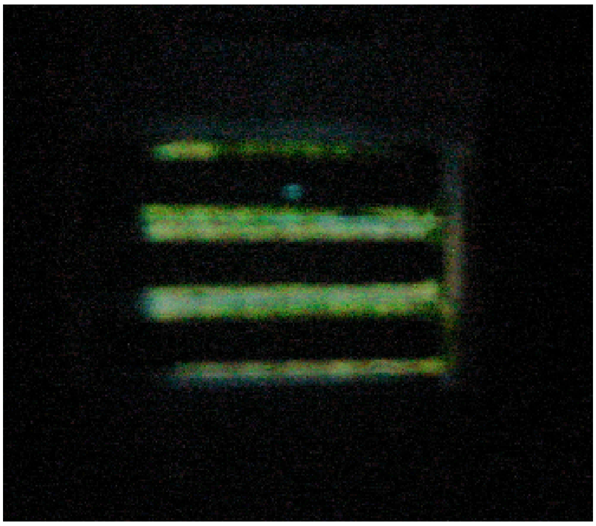
**Using sunlight to power our homes and offices is an unaccomplished dream due to the still inefficient technology for a better use of solar energy. The study of photosynthesis in plants could provide new clues by explaining how they absorb almost 100% of the sunlight reaching them, and how they transform it into other forms of energy. Researchers Michael Haumann and Holger Dau, from the Freie Universität Berlin, used the X-ray source of the European Synchrotron Radiation Facility (ESRF) to investigate the kinetics of the photosynthesis process. They have confirmed the existence of a fifth step in the catalysis process converting water into oxygen, and have published their results in Science.**

Chlorophyll in plants absorbs light from the sun, which then becomes energy used by the so-called "oxygen-evolving complex" to catalyse the splitting of water into molecular oxygen. This complex contains four manganese and one calcium atom that are known to be at the centre of the catalytic reaction. Five intermediate states have been proposed in the process of photosynthesis - a cycle known as the "Kok cycle" - but only four had been proved until recently. With the help of the ESRF, scientists have been able to identify the missing state, which is particularly important because it is directly involved in the molecular oxygen formation. They suggest, furthermore, an extension of the "Kok cycle" with an additional intermediate and propose a new reaction mechanism on a molecular basis for the release of dioxygen. This gives new insight into the mechanism of photosynthesis.

In order to study this process, the use of synchrotron light was crucial: "A very intense and stable X-ray beam is necessary to perform this study on such a complex, highly diluted protein present in the investigated spinach sample", explains Pieter Glatzel, head of beamline ID26, where the experiments were carried out. The researchers measured the fluorescence from the sample that is emitted after excitation with X-rays.

They flashed the sample with a laser and registered the change using X-ray fluorescence every 10 microseconds to find out how different oxidation states developed. When carefully analysing the reaction kinetics, they observed a time delay before the O2-evolving step. This delay unambiguously proved the existence of the long-searched for intermediate state.

How far away are we then from using the sun to power our daily lives? Michael Haumann, the main author of the publication, asserts that "these are important results that will make an impact in the photosynthesis community. They help our understanding of how solar energy is used in plants and contribute to the efforts to produce more efficient solar cells for our needs".



**Glowing in the dark.** The sample containing Photosynthesis II extracted from spinach is illuminated with X-rays at -260 degrees. The intense beam creates highly reactive species that rest at low temperatures but trigger chemical processes when warmed up to room temperature. These reactions cause the green 'glow'.

*Reference: Haumann et al., Photosynthetic $O_2$ formation tracked by time-resolved x-ray experiments, Science, vol 310 (1019-1021).*