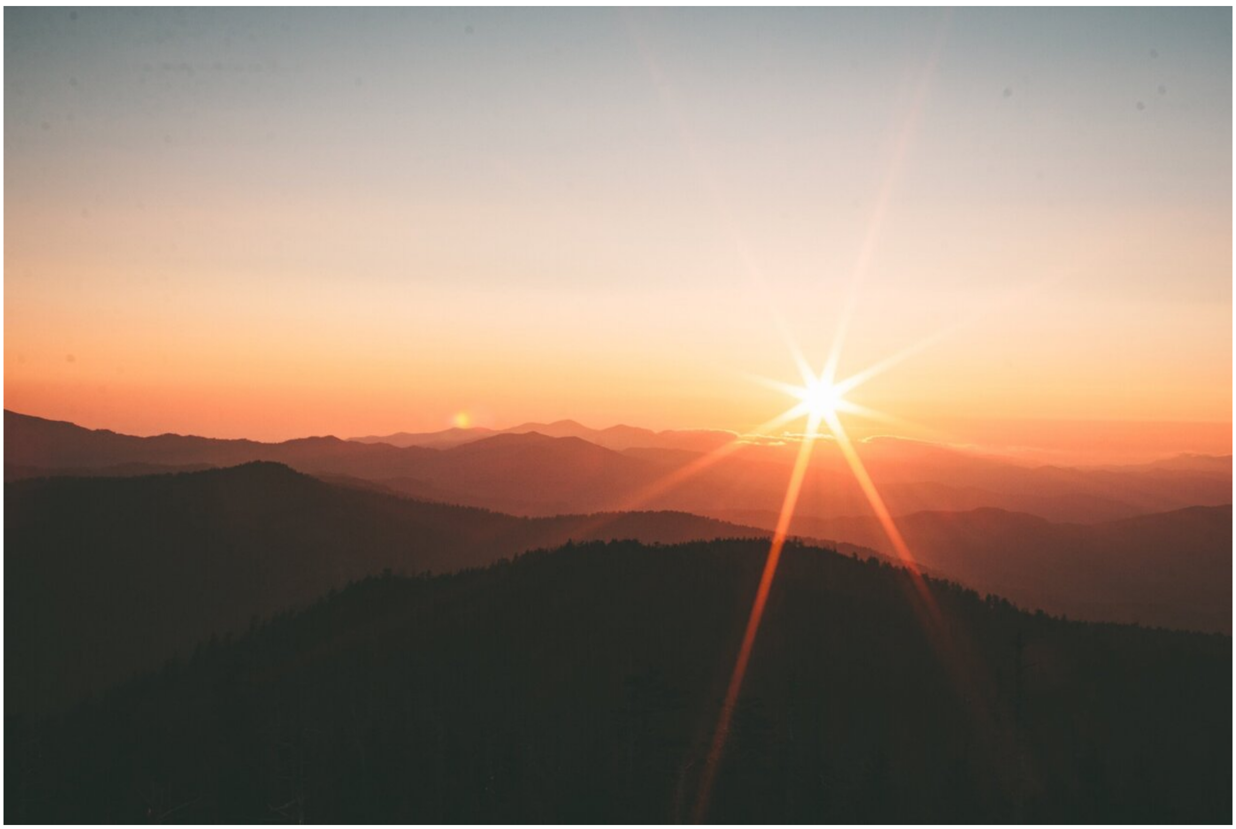
Study unlocks the power of visible light for sustainable chemistry

March 28 2024



Credit: Unsplash/CC0 Public Domain

A breakthrough in sustainable molecular transformations has been achieved by researchers at the University of Helsinki. Led by Professor Pedro Camargo, the team has developed an important way to harness the power of visible light to drive chemical processes with greater efficiencies, offering a greener alternative to traditional methods.

Their findings, published in the journal *ACS Applied Materials and Interfaces*, could revolutionize how we produce essential chemicals and fuels.

Overcoming cost and efficiency barriers

Traditional plasmonic photocatalysis has long been hindered by the high cost and scalability issues associated with materials like silver (Ag) and gold (Au). However, Professor Pedro Camargo and his team have overcome these barriers by focusing on materials that are readily available on Earth in significant quantities.

These materials are important because they can be used in various applications without worrying about scarcity or depletion. Specifically, the team focused on H_xMoO_3 as a plasmonic photocatalyst, which was combined with palladium (Pd), an important catalyst widely employed in various industries. Their approach involves a solventless mechanochemical synthesis technique, offering both cost-effectiveness and environmental sustainability.

The power of light

The researchers delved into the intricate interplay of optical excitations and discovered that, by shining specific wavelengths of visible light on their catalyst, they could significantly boost its performance. Most remarkably, using two wavelengths of light at the same time resulted in an 110% increase in reaction efficiency. This enhanced efficiency is attributed to the optimized generation of energetic electrons at the catalytic sites, a crucial step forward in sustainable catalysis.

They identified the synergistic effects of H_xMoO_3 band gap excitation, Pd interband transitions, and H_xMoO_3 localized surface plasmon resonance (LSPR) excitation, leading to remarkable enhancements in catalytic performance.

A greener future for chemical industries

"Our work offers a major step forward in making chemical processes more sustainable," says Professor Camargo. "By using light as an energy source, we could potentially revolutionize how vital chemicals are produced, reducing the need for fossil fuels and harsh conditions in current industrial processes."

This research has immense potential for applications ranging from cleaner fuel production to manufacturing essential materials with less environmental impact.

The implications of this research extend far beyond the laboratory, offering hope for a greener, more sustainable future as society strives to combat climate change and transition towards renewable energy sources.

More information: Leticia S. Bezerra et al, Triple Play of Band Gap, Interband, and Plasmonic Excitations for Enhanced Catalytic Activity in Pd/HxMoO3 Nanoparticles in the Visible Region, *ACS Applied Materials & Interfaces* (2024). DOI: 10.1021/acsami.3c17101

Provided by University of Helsinki