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Plasmon-Mediated Photocatalytic Conversion of Methane and Nitrous Oxide to Multicarbon Hydrocarbons under Ambient Conditions

Stanford researchers have developed a light-driven catalyst system that converts methane and nitrous oxide into higher-value hydrocarbons under mild conditions. The technology could help reduce greenhouse gas emissions while producing useful chemical building blocks. Methane and nitrous oxide are powerful greenhouse gases, but they are difficult to convert selectively into valuable chemicals using existing processes. Conventional methane conversion often requires high temperatures, high pressures, and large centralized infrastructure, while nitrous oxide is usually treated as a waste gas rather than a useful reactant. The inventors have developed a plasmon-mediated photocatalytic system that uses visible light to drive the selective coupling of methane and nitrous oxide under ambient or near-ambient conditions. The catalyst converts these gases into multicarbon hydrocarbons such as ethane, ethylene, propane, and propylene while reducing unwanted overoxidation. This approach could support greenhouse gas upgrading, distributed chemical production, and lower-carbon fuel and chemical synthesis.

Stage of Development: Proof of concept

Applications

- Greenhouse-gas mitigation and valorization
- Industrial emissions and vent-stream treatment
- Distributed and modular chemical manufacturing
- Solar-driven fuel and chemical synthesis

Advantages

- Operates under ambient conditions using visible light
- Simultaneously mitigates two potent greenhouse gases
- High selectivity toward multicarbon hydrocarbons
- Avoids high-temperature, high-pressure processing
- Tunable Au–Pd/TiO2 catalyst platform
- Compatible with scalable, modular reactor designs

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