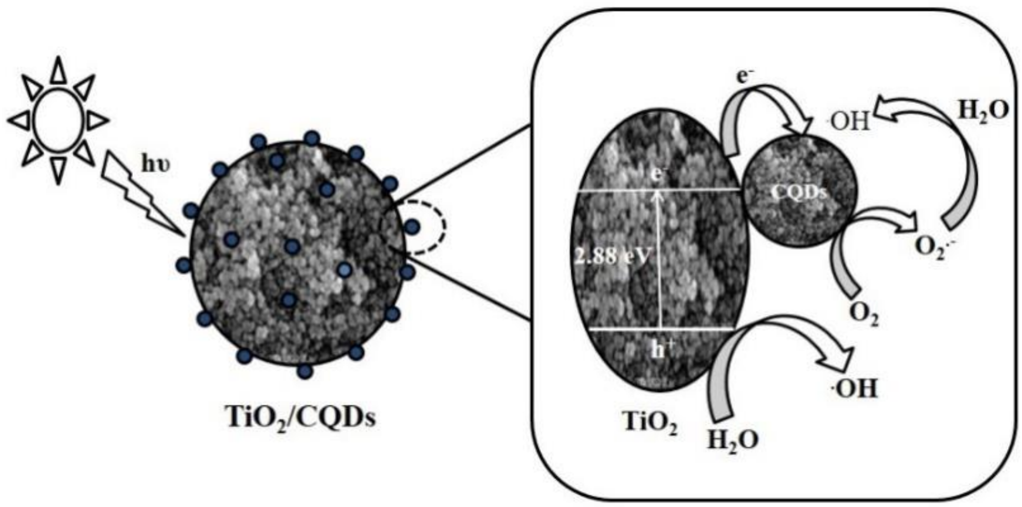
Technology to convert plant lignin to commodity chemicals using sunlight

The complex and highly stable nature of lignin presents challenges in its decomposition and extraction. The lignin's catalytic conversion has remained a scientifically fascinating research problem that could bring achievable rewards. Photocatalysis is being considered as one of the classical techniques in the transformation of lignin to simple phenolics. Scientists at DBT's Center of Innovative and Applied Bioprocessing (CIAB), Mohali demonstrate the facile promising photocatalytic decomposition of lignin to value-addition chemicals in an aqueous medium using the synthesized heterogeneous carbon quantum dots (CQDs) decorated titanium dioxide (TiO2) catalyst.



Schematic illustration of charge separation and transfer in TiO_2 / CQDs for the lignin decomposition

The solar light illumination technique enabled the degradation of alkali lignin up to 99%, resulting in different lignin derivatives, such as m-anisic acid (3-methoxybenzoic) acid and p-hydroxybenzoic acid (PHBA or 4-hydroxy benzoic acid) through the plausible oxidation mechanism. These resultant compounds find a range of industrial applications; for example, PHBA as a precursor in the pharmaceutical industry (for antibiotics preparation) and polymer industry (for yarn production). The conversion technology's detailed information can be found in the recently published article in the peer-reviewed journal, *Applied Catalysis A: General*.

Lignin presents an extraordinary opportunity to produce bio-based products, such as low molecular weight compounds like phenols, alkylphenols, and phenol resins that can replace products obtained from fossil resources. The natural lignin is a complex, dense, and amorphous polymer located in the secondary cell wall of terrestrial plants with amounts ranging between 10-25% of the plant biomass (dry basis). p-hydroxyphenyl (H), guaiacyl (G) and syringyl (S) are the principal subunits that contribute to the formation of the lignin matrix. Similarly, the carbon-carbon, ester, and ether linkages are the primary cross-linked linkages connecting the subunits, offering significant challenge in its decomposition due to the complex and highly stable nature.

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