What an electron-hole pair upon UV irradiation of TiO$_2$ can do besides the red-ox reactions

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Nanotechnology and Photocatalysis

Group of Prof. Detlef Bahnemann
Back to Argentina!

Mar del Plata

Our research group
at the National University
of Mar del Plata
Fields of Applications

- **Environmental Remediation:** Water and Air Decontamination
- **Technology:** Self-Cleaning materials
- **Technology:** Anti-Fogging
- **Energy:** H₂ / CH₄ Production
- **Desinfection:** Anti-Bacterial
- **Super-hydrophilicity**
Principle of (heterogeneous) photocatalysis

E / eV

$h^+ + e^- \rightarrow \text{Pollutant} \rightarrow \text{Ox}^+ + \text{Red}^-$

$\text{TiO}_2 \rightarrow \text{CO}_2, \text{Cl}^-, \text{H}^+, \text{H}_2\text{O}, \text{etc}$
How to assess the photocatalyst surface

Attenuated Total Reflection – IR Spectroscopy

![Diagram showing Attenuated Total Reflection (ATR) setup](image)
Oxalic acid and TiO$_2$ (anatase)
Water and TiO$_2$ (anatase)
Bending mode of Water
The model: DEAGGREGATION
Estimation of the added Water

\[ V'_{\text{ref}} = V_{\text{ref}} + V_{\text{H}_2\text{O}} = x \times y \times (z_2 @ t_1) \]

\[ V'_{\text{ref}} = V_{\text{ref}} + V_{\text{H}_2\text{O}} + V_{\text{H}_2\text{O}}^{\text{add}} = x \times y \times (z_2 @ t_2) \]

Bulk H$_2$O

\[ V_{\text{ref}} + V_{n,o} \]

ZnSe

\[ Z_1 \]
\[ V_{\text{H}_2\text{O}} \text{ added} = 0.15 \text{ ml that is } 18 \% \]
Summary

- Enhanced adsorption of oxalic acid under UV irradiation
- Bending mode of water in a wet TiO₂ layer rises only under UV irradiation
- The wet TiO₂ layer expands with a volume of water: free and adsorbed
- Inactive e-/h+ pairs become active: DEAGGREGATION

Open questions

- Additional surface area is generated upon UV irradiation: the same magnitude in the presence of any pollutant?
- The particles do not swim away, why?: EZ?
Thank you!