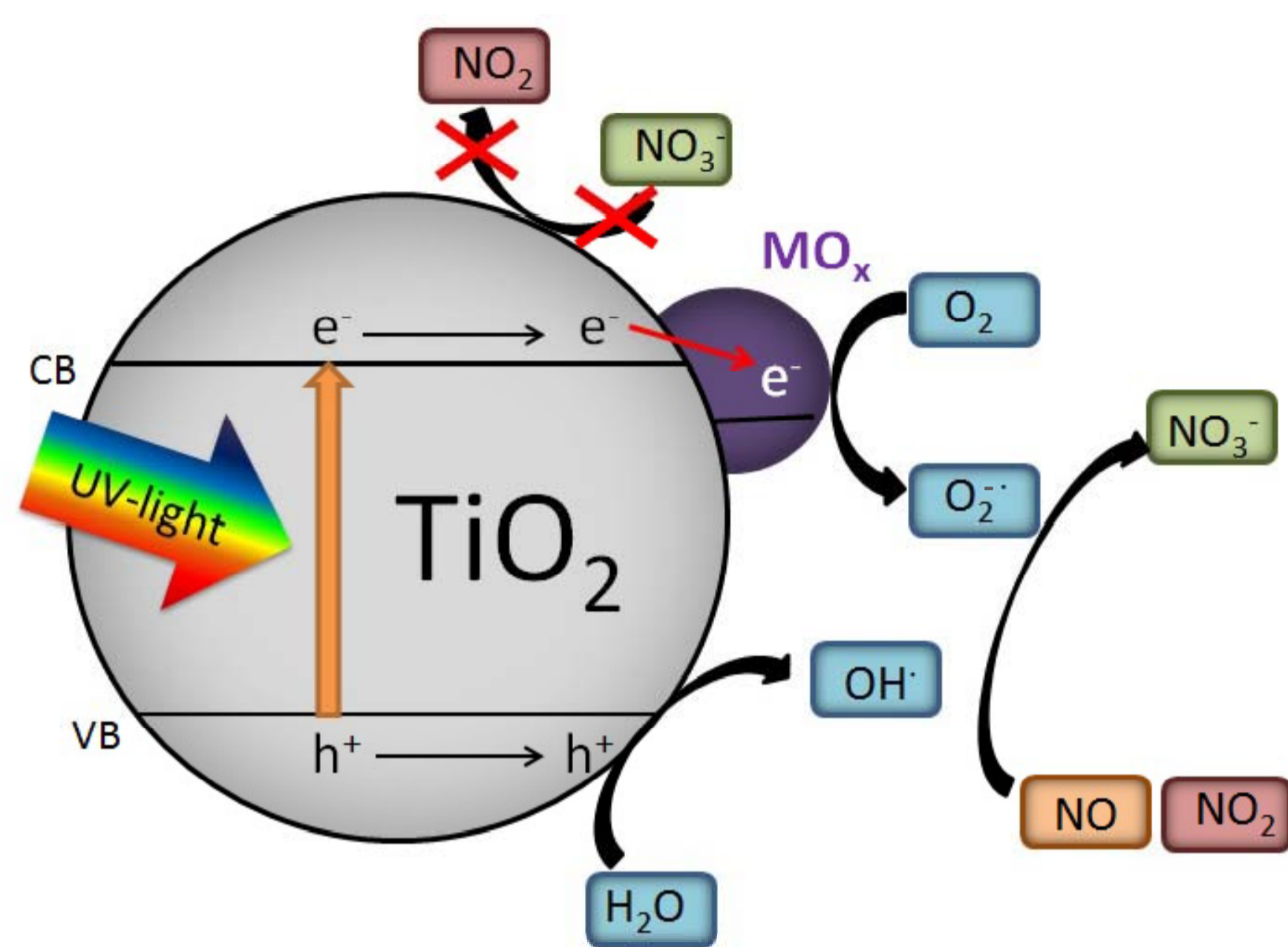


Increasing the Selectivity of DeNO_x Photocatalysts and Suppressing the Evolution of Toxic By-Products

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Photocatalysis

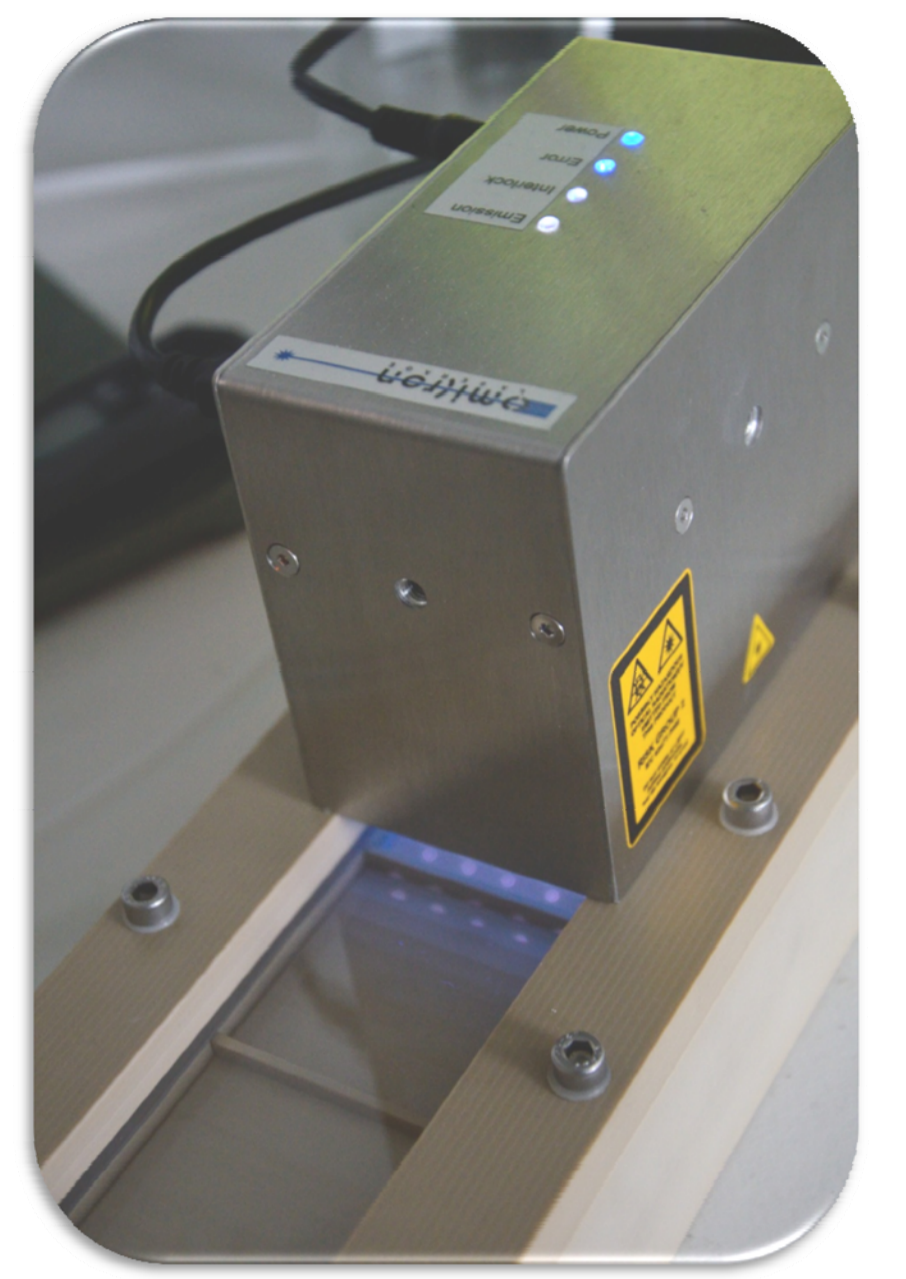


- Reduction of O₂ to superoxide or H₂O₂ by CB electrons
- Oxidation of water to ·OH by VB holes
- O₂⁻, H₂O₂ and ·OH can oxidize NO_x to the nitrate
- Removal of NO₃⁻ from the surface by rain
- Adsorbed NO₃⁻ can be re-reduced to NO₂ by CB electrons
- Re-reduction in competition with O₂ reduction
- Co-Catalysts support the full oxidation to nitrate and suppress the back reaction from nitrate

1

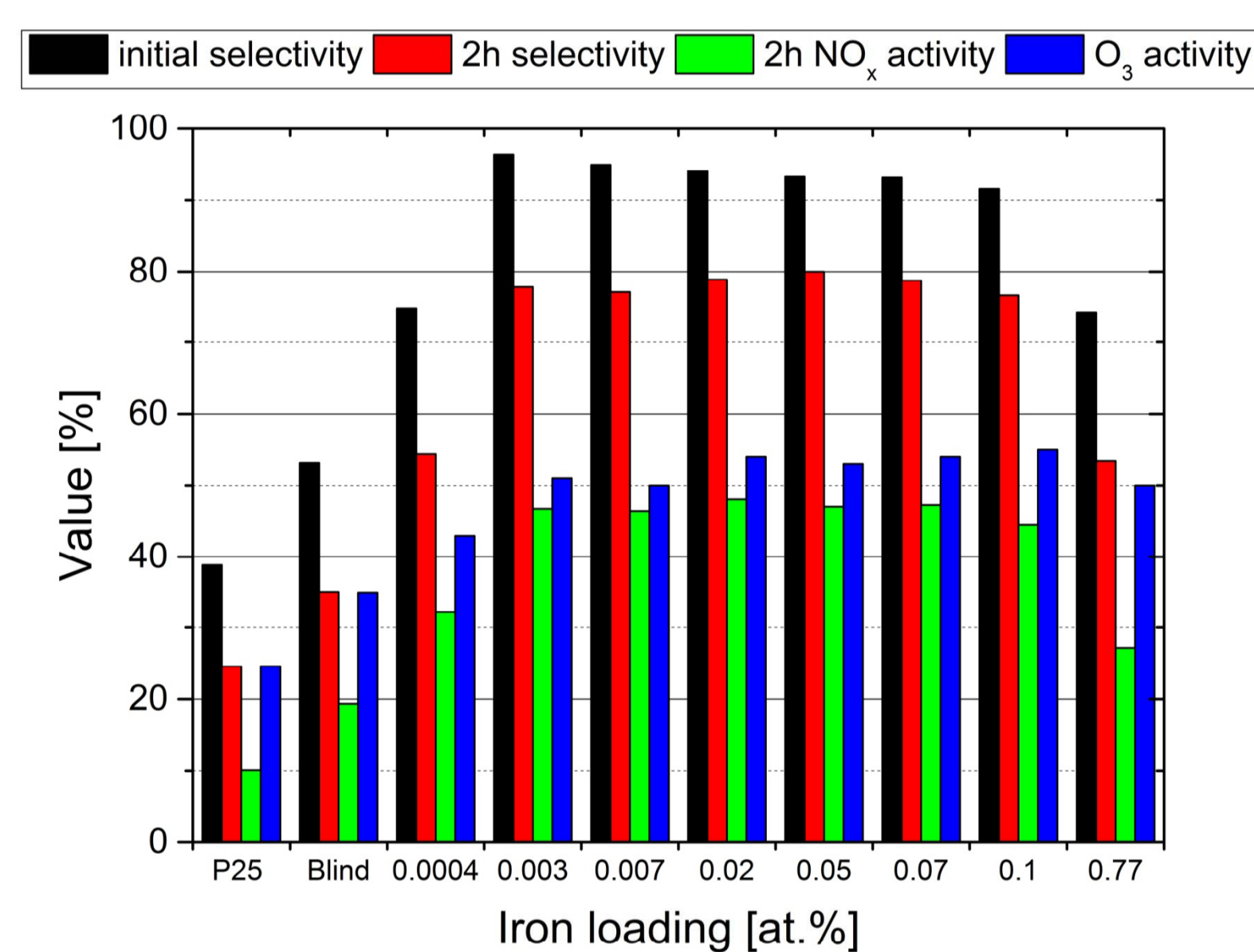
Measurements

- Based on the ISO standard 22197-1
- Gas flow of 3 L/min
- UV light of 1 mW/cm²
- 50 % relative humidity
- 1 ppm NO or 1 ppm O₃
- Aeroxide P25 (Evonik)



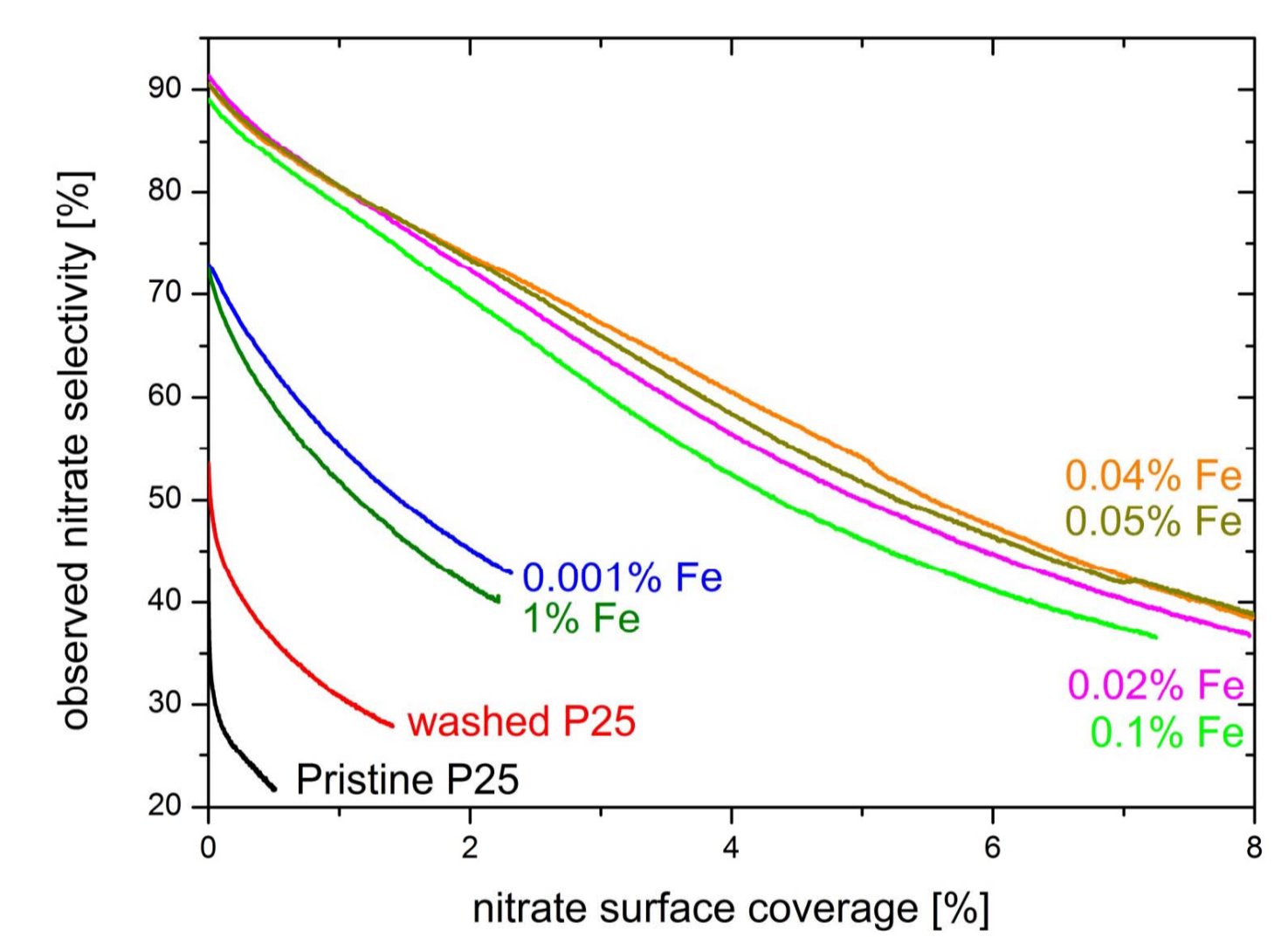
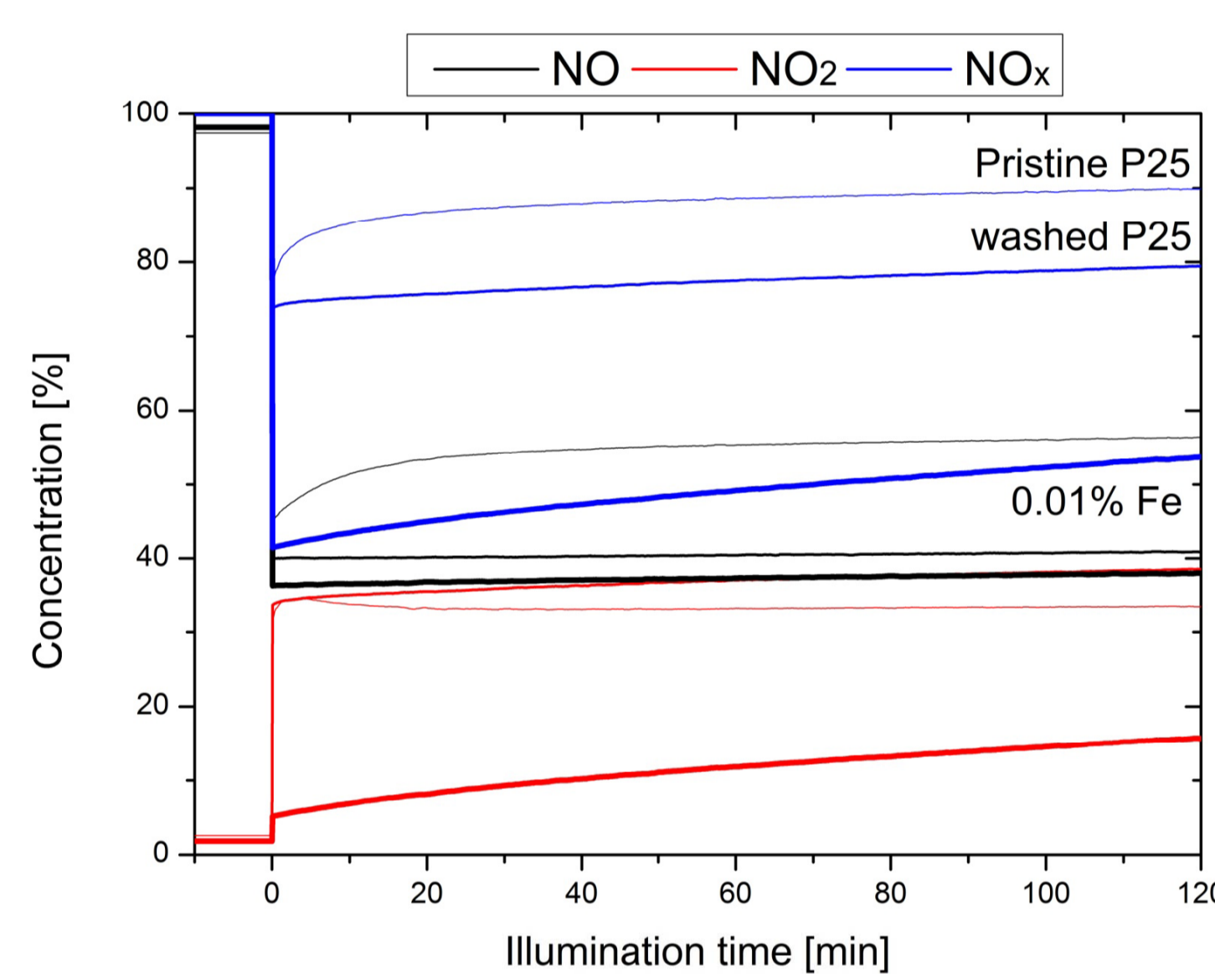
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Influence of iron grafting



Optimum concentration for P25:

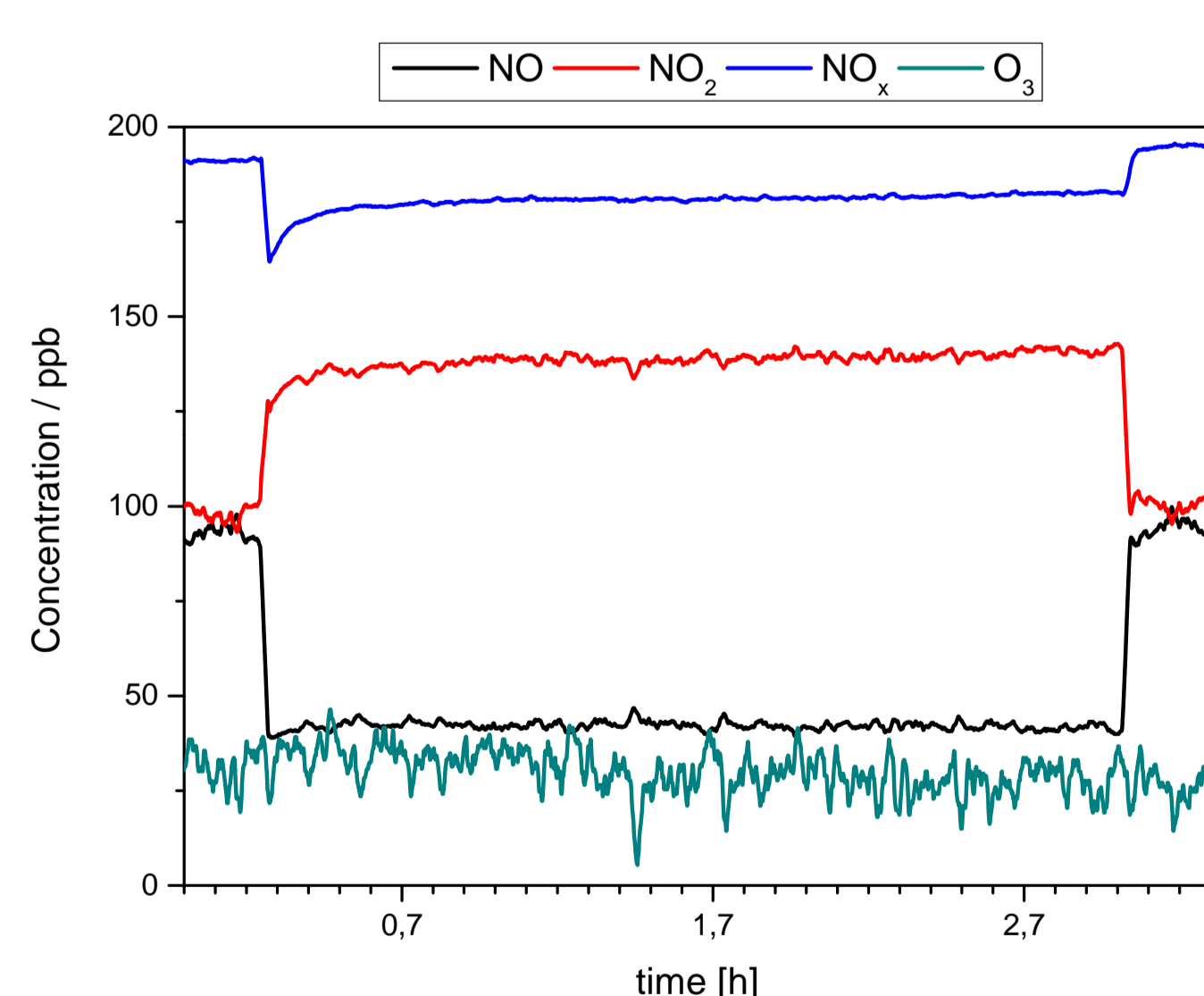
0.003 to 0.1 mol% iron
10 to 400 Fe³⁺/particle



- Up to 120 % higher selectivity and 110 % activity by modification with Fe³⁺
- The release of NO₂ is drastically delayed and only happens after long exposure times
- Higher tolerance towards nitrate poisoning, the high selectivity is retained for a much longer time
- Higher possible nitrate accumulation on the surface

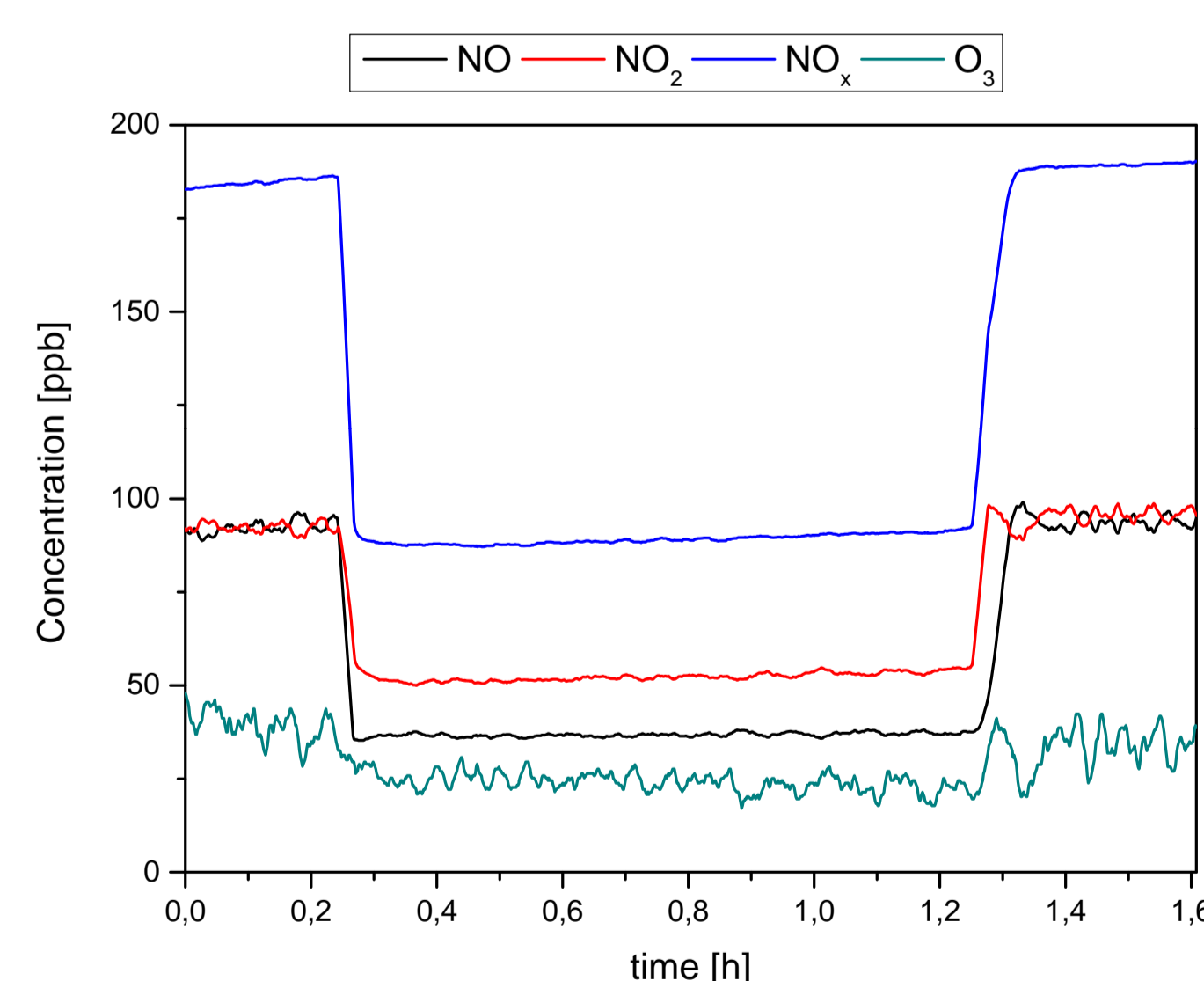
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Environmentally relevant mixture of NO, NO₂ and O₃



Unmodified P25:

- Low activity for NO_x degradation (8%)
- NO is mainly converted to NO₂
- NO₂ is increased by 40%.



P25 grafted with just 0.04 mol% Fe:

- Degradation of NO, NO₂ and O₃
- High NO_x degradation activity (50%)
- 40% decrease in NO₂

4

Summary & Literature

- Highly selective and active photocatalyst by grafting of low amounts of iron on the surface
- Long term stable materials against catalyst poisoning of nitrate
- Significant degradation of NO, NO₂ and ozone in environmentally relevant mixtures
- J. Patzsch, J. Z. Bloh, Catal. Today, accepted (2017)
- J. Patzsch, A. Folli, D. MacPhee, J. Z. Bloh, PCCP, accepted (2017)

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