

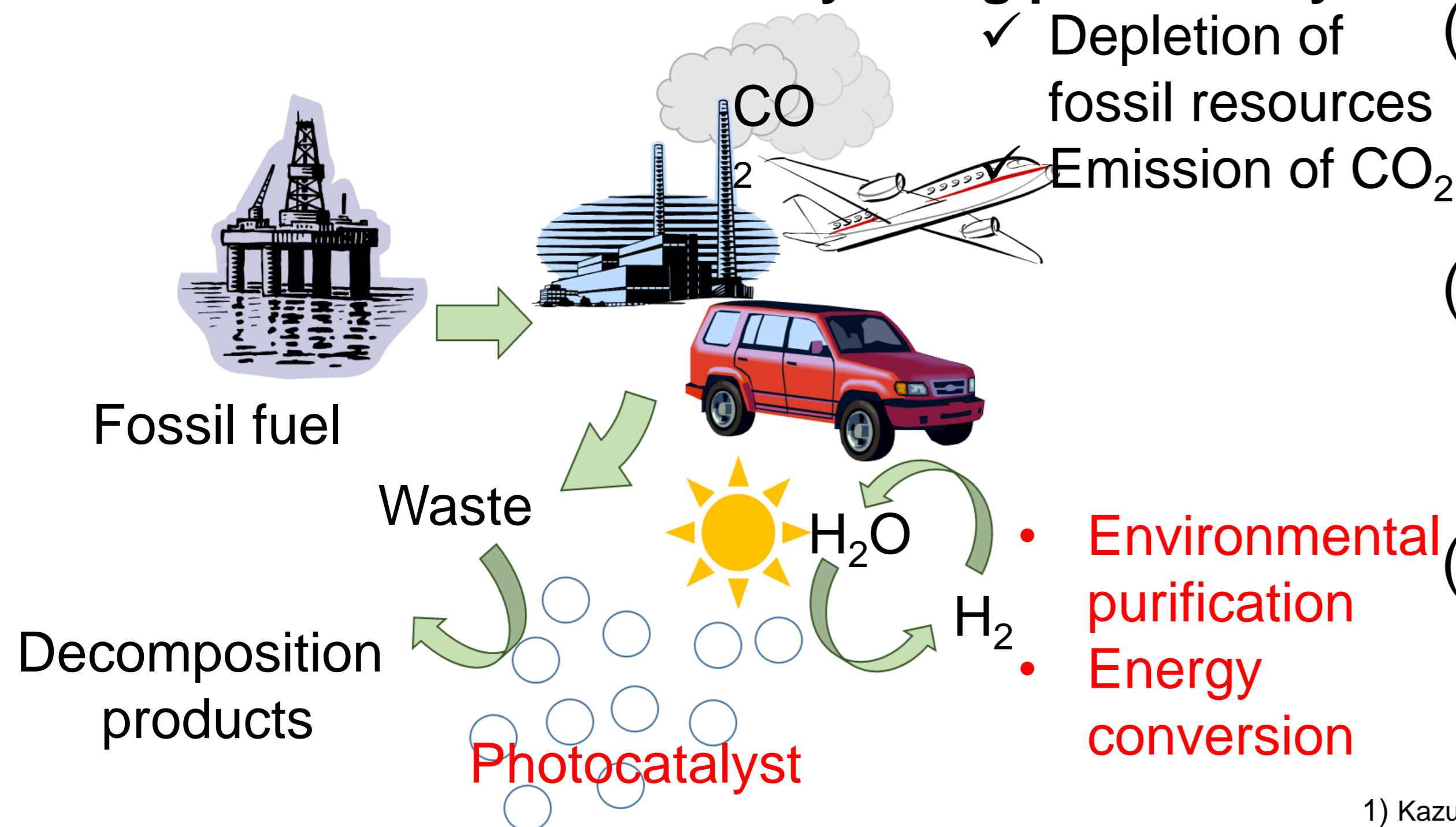
Spectroscopic Study for Hydrophilic Surface of TiO₂ Photocatalysts Modified with Au Nanoparticles

Hayato Kondo, Yosuke Kageshima, Hiromasa Nishikiori

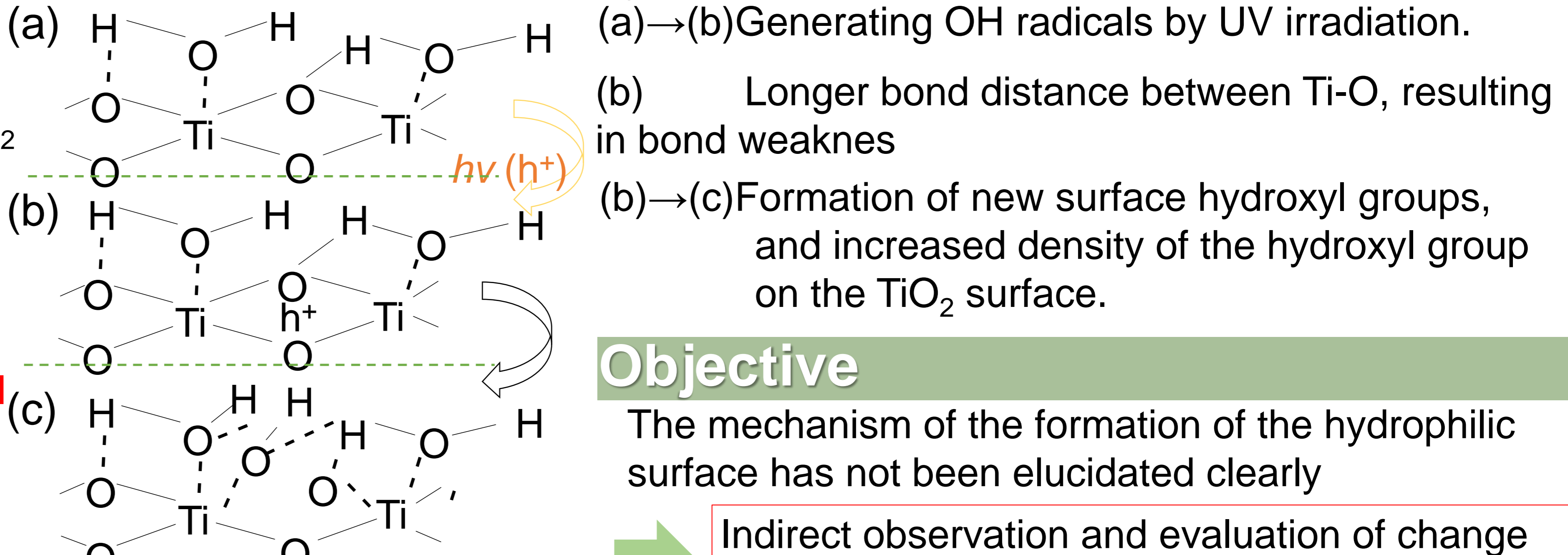
¹Department of Engineering, Graduate School of Science and Technology, Shinshu University, Nagano, Nagano, Japan

Introduction

A clean and sustainable society using photocatalyst



Reaction process on photocatalyst powder surface¹⁾

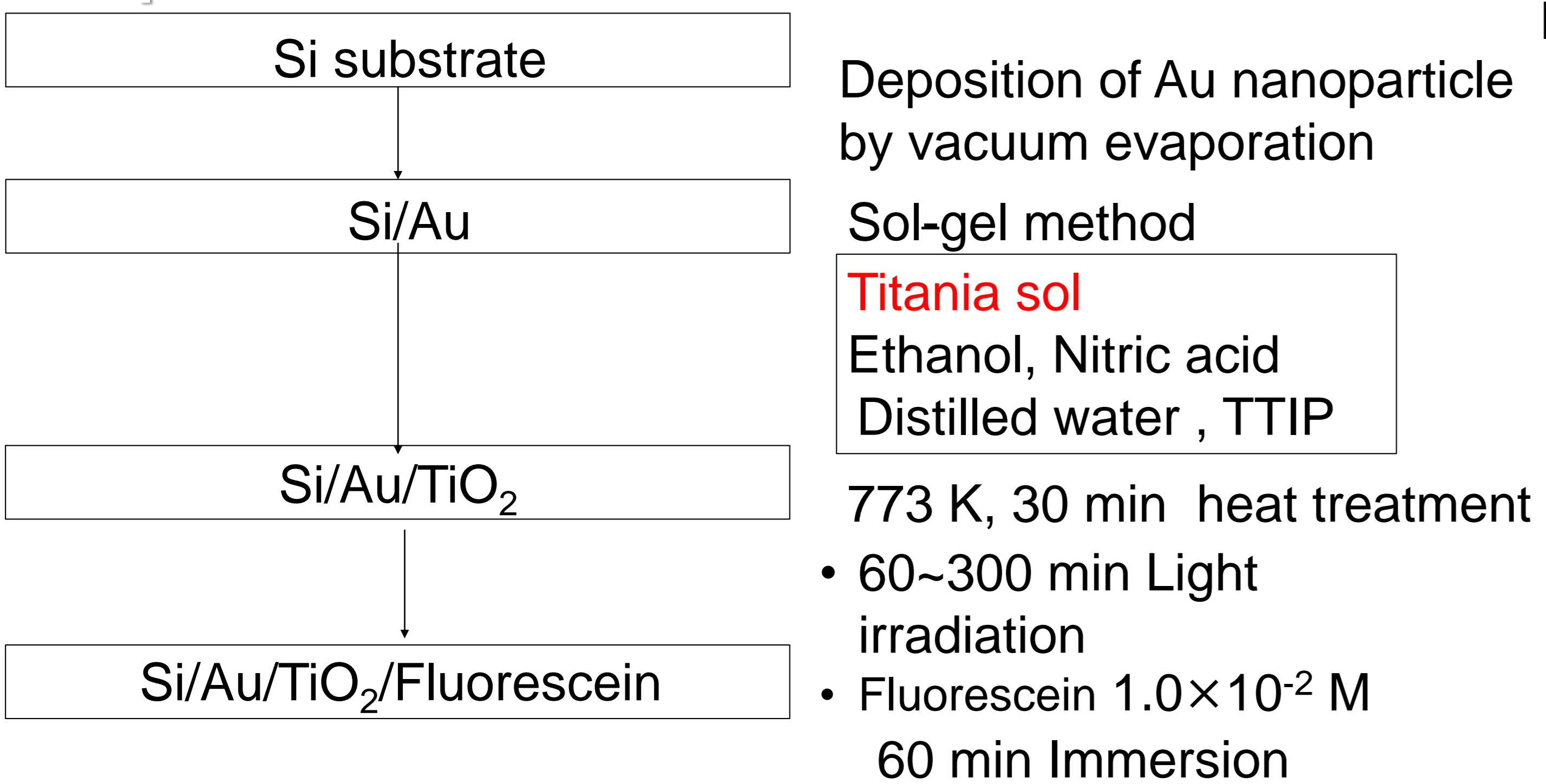


Objective

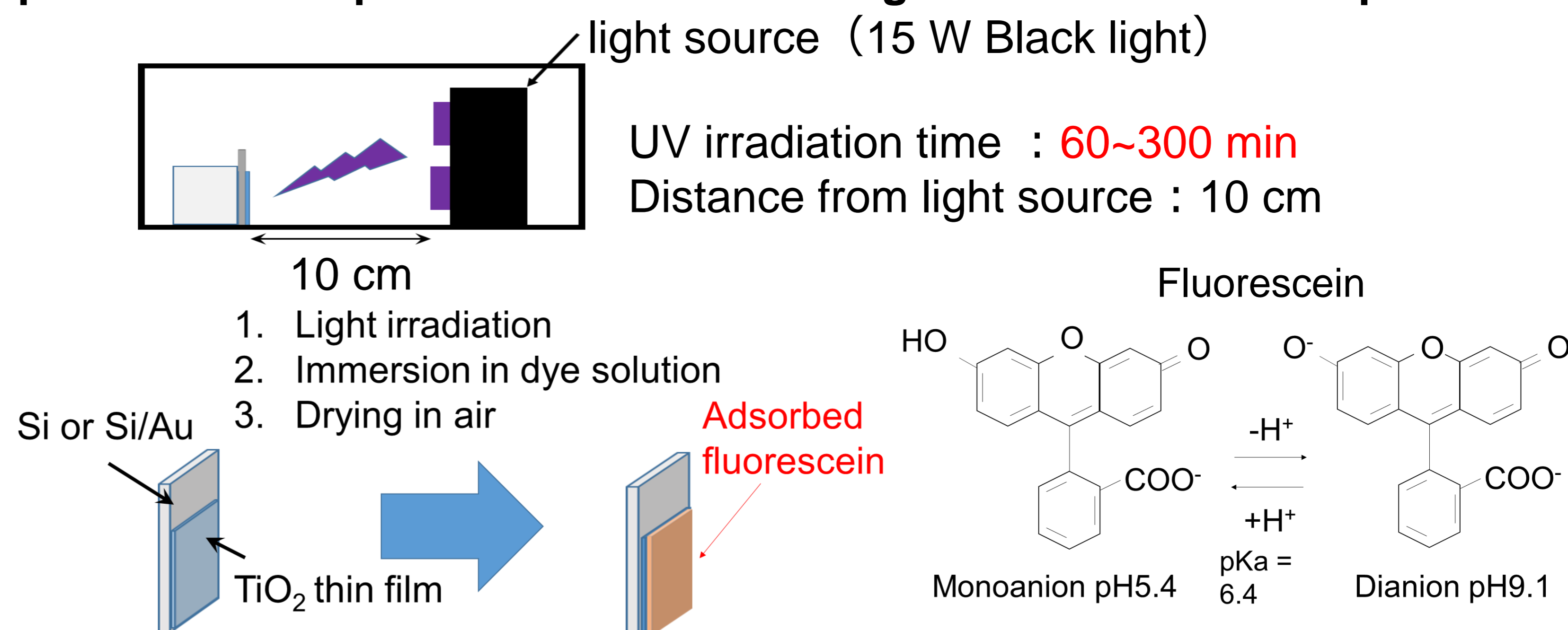
The mechanism of the formation of the hydrophilic surface has not been elucidated clearly

Indirect observation and evaluation of change in TiO₂ surface by adsorption of organic dye

Experimental

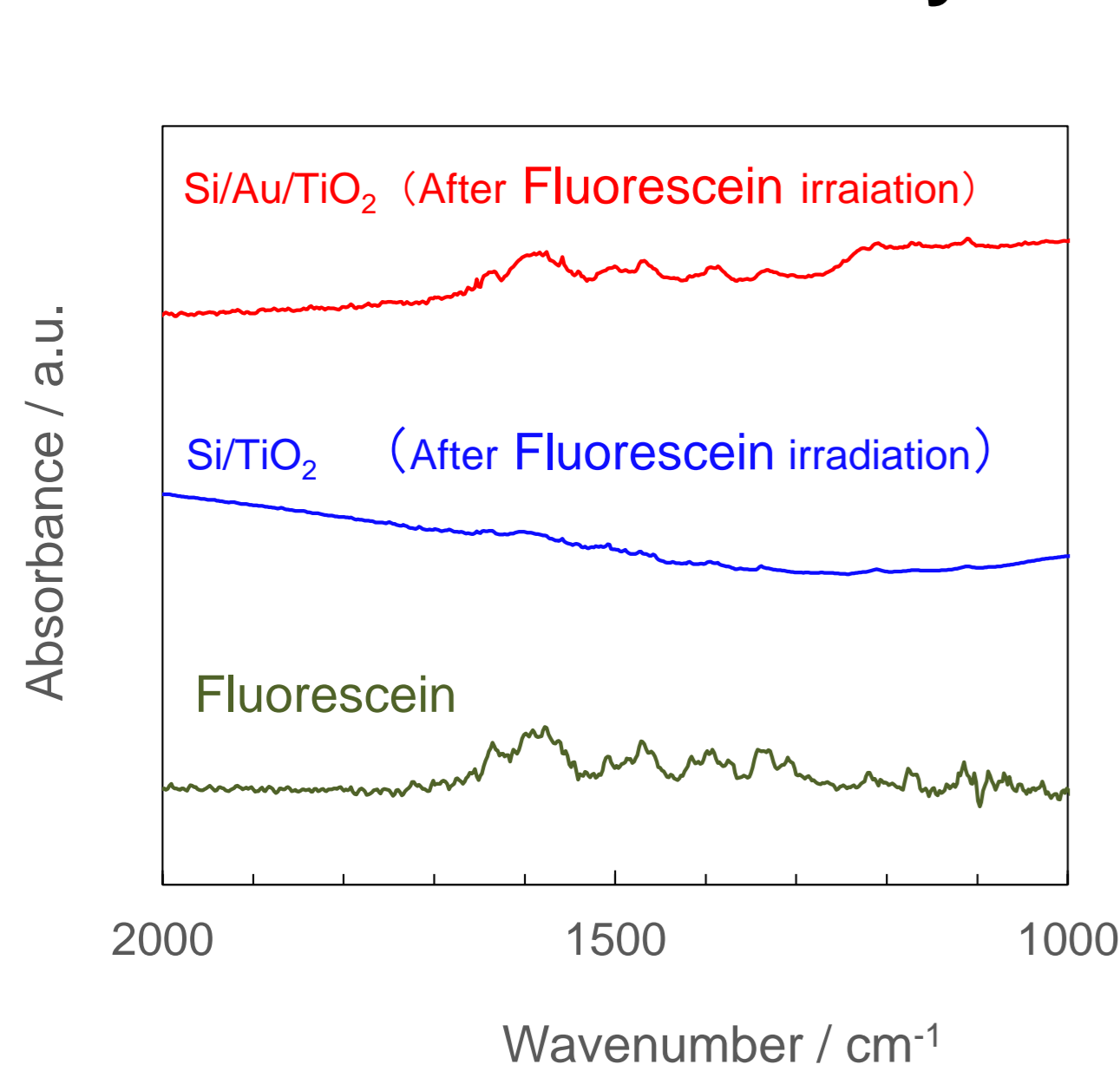


Experimental setup for measurements of light irradiation time dependence



Result and Discussion

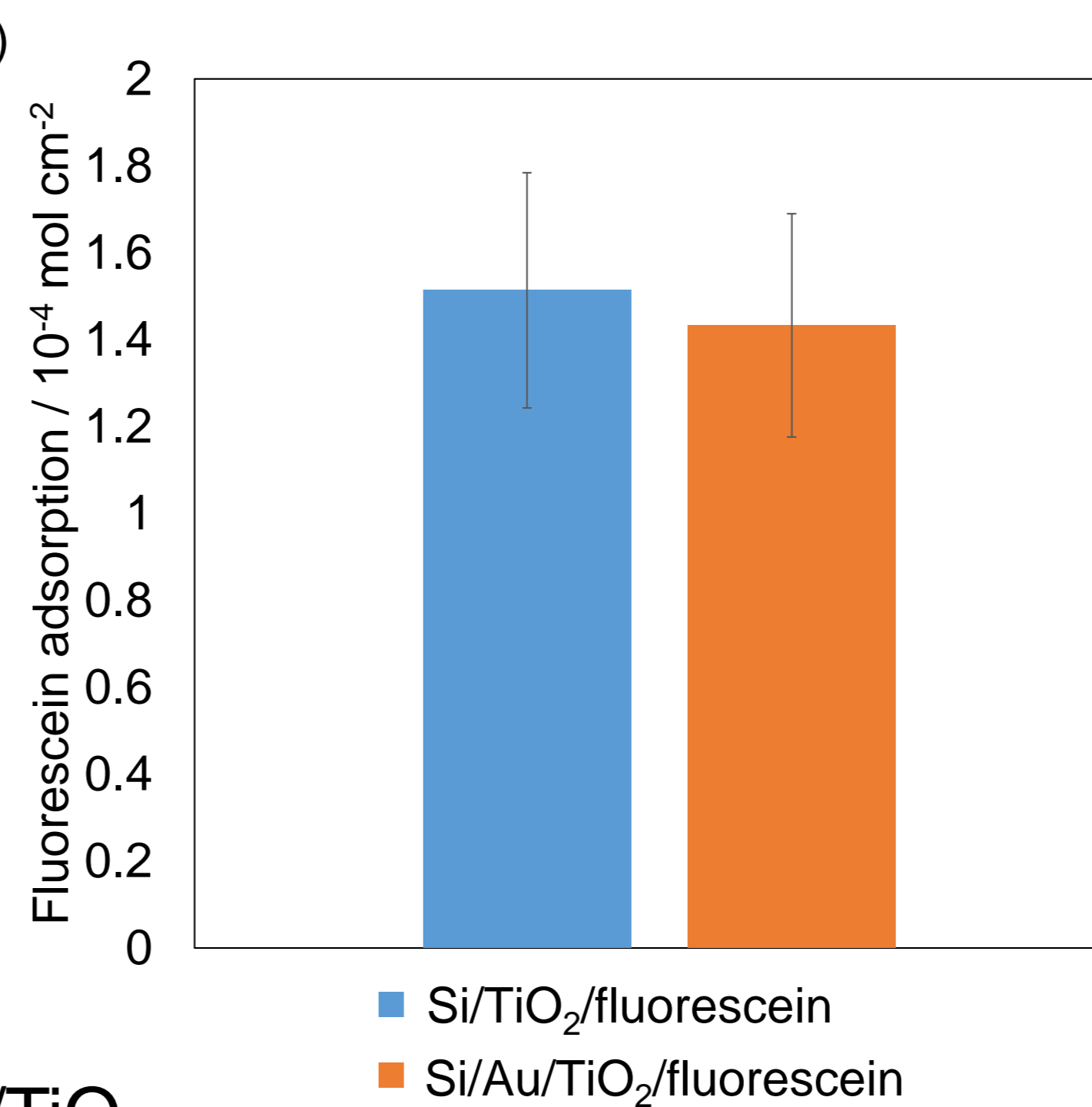
Observation of adsorbed dye on TiO₂ surface by FT-IR



Peak position of each vibration mode¹⁾

Wavenumber / cm ⁻¹	Vibration mode
1115	Asymmetric CCH bend, C-O stretch, C-C stretch
1171	CCH bend
1215	CCH bend, COC stretch and bend
1310	CCH bend, CC stretch, phenoxide C-O stretch
1330	CC stretch (XR stretch)
1393	COO ⁻ Symmetric stretch
1460	CO, CC stretch (quinone-like)
1497	Central ring breathing, CC stretch
1544	CC stretch
1573	COO ⁻ Asymmetric stretch

Adsorbed amounts of fluorescein on TiO₂



The adsorbed fluorescein was redissolved in 1.0 × 10⁻² M HCl and the absorption spectrum of the solution was measured

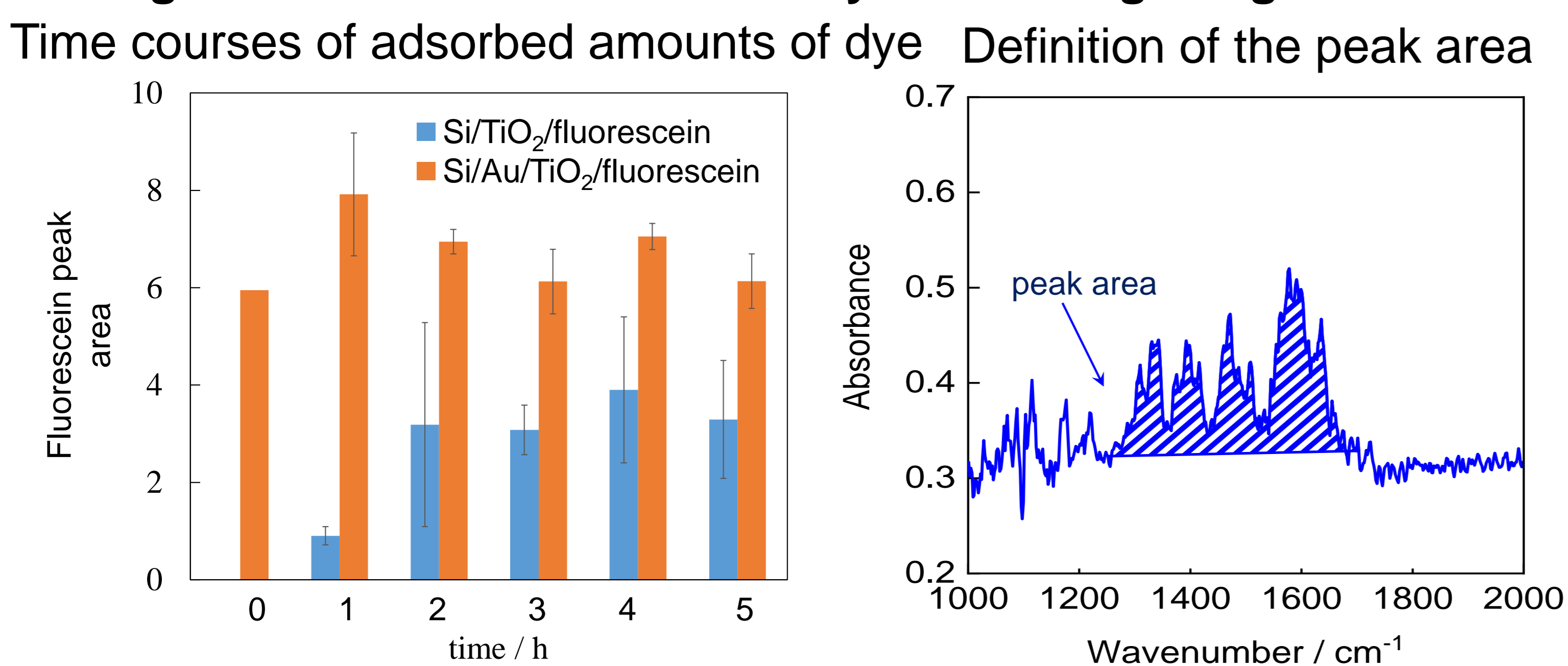
There was no significant difference in adsorbed amounts of fluorescein with or without gold modification

Enhanced IR absorption by gold surface plasmon resonance

✓ No significant peak was confirmed in Si/TiO₂ after fluorescein adsorption

✓ A peak of adsorbed fluorescein was confirmed at 1300-1700 cm⁻¹ in Si/Au/TiO₂

Changes in amounts of adsorbed dye according to light irradiation time



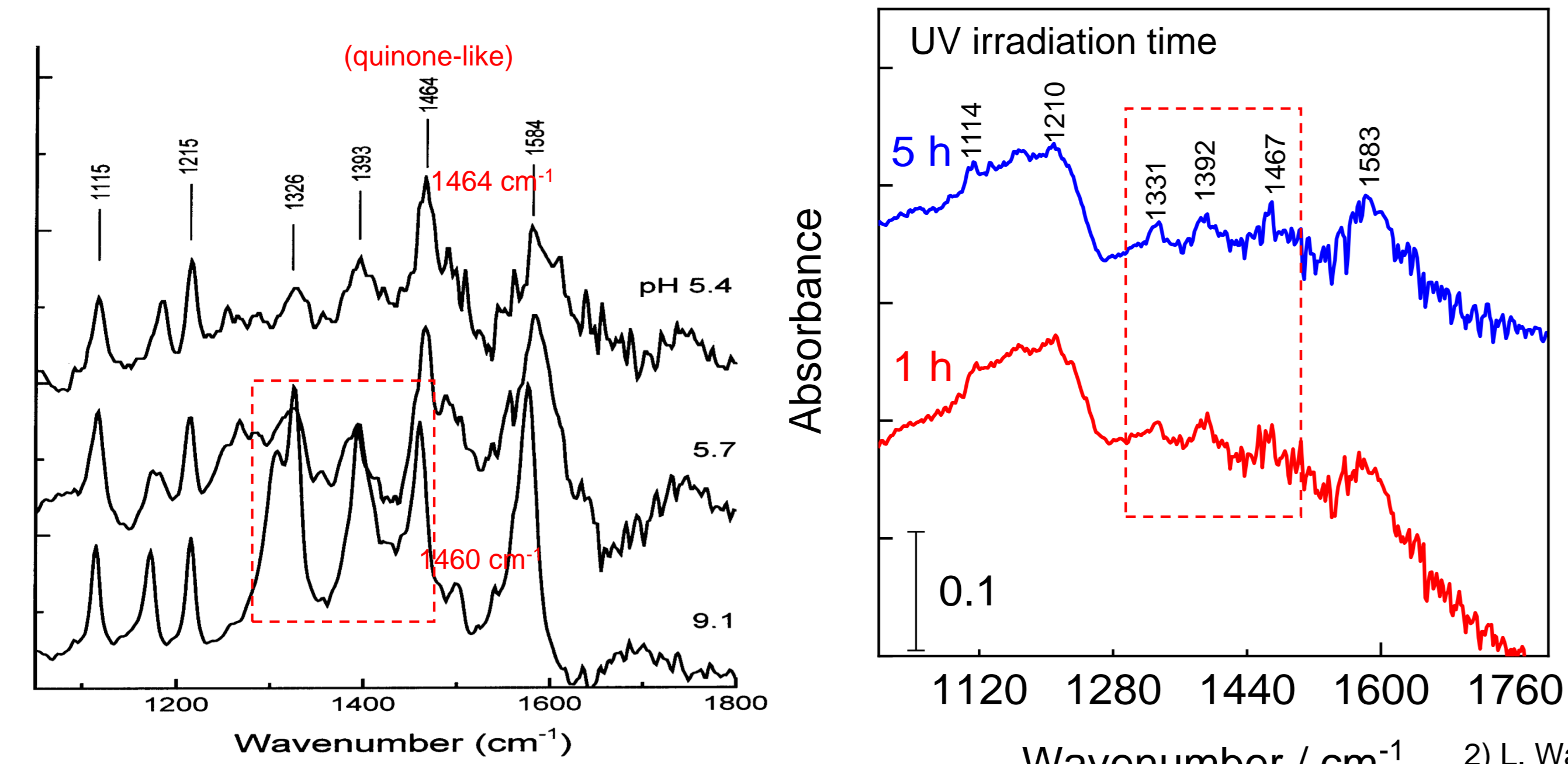
- ✓ In the case of Si/TiO₂, the peak area of the IR absorption peak of fluorescein is increased by UV irradiation time longer
- ✓ In the case of Si/Au/TiO₂/fluorescein, regardless of UV irradiation time, the peak area of the dye is almost constant
- Changes in actual surface conditions may be completed within 1 hour of light irradiation
- Enhanced surface plasmon enhancement of gold allowed accurate tracking of adsorbed dye

Conclusion

- Significant IR absorption of fluorescein could be observed by-with using gold modified Si/TiO₂
- There was no significant difference in adsorption amount regardless of the gold modification
- ➔ Fluorescein could be observed by surface plasmon enhancement of gold
- Regardless of UV irradiation time, the peak area of adsorbed dye was almost constant
- From the shape of the IR spectrum, almost all adsorbed dyes are considered to be in the form of dianion
- ➔ Investigation of adsorbed dye in a shorter time and detailed observation of temporal change in surface condition are future issues

Changes in IR spectra of adsorbed dye according to light irradiation time

IR spectra of fluorescein aqueous solution at different pH²⁾



- ✓ No significant change in spectral shape could be confirmed at 1 and 5 hours of light irradiation
 - ✓ Almost all adsorbed dyes are considered to be in the form of dianion
- Observation for adsorbed dye in a shorter time scale should be necessary