



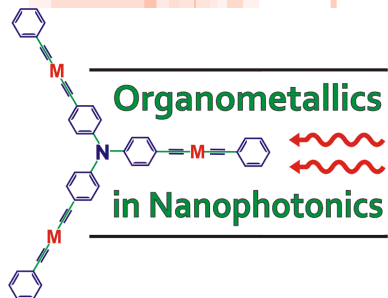
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INNOVATIVE ECONOMY  
NATIONAL COHESION STRATEGY



EUROPEAN UNION  
EUROPEAN REGIONAL  
DEVELOPMENT FUND



# BEHAVIOR OF THE $\text{Na}_2\text{S}$ STABILIZED AND UNSTABILIZED GOLD NANORODS UPON IRRADIATION WITH FEMTOSECOND LASER

Marta Gordel

Wrocław University of Technology

## MARKET SQUARE



## TOWN HALL



## SALT SQUARE



## WROCLAW

600 thousands inhabitants,  
150 thousands students,  
3rd academic centre  
in Poland

## CATHEDRAL



## UNIVERSITY OF TECHNOLOGY



## CENTRE

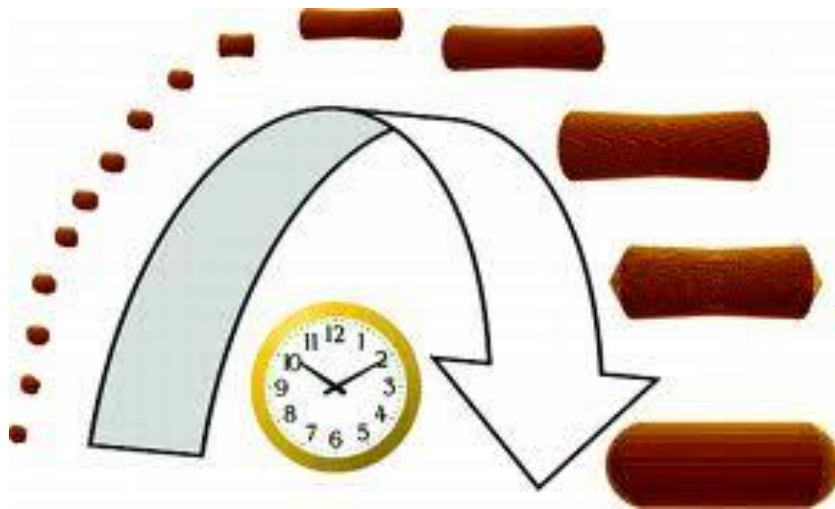


## UNIVERSITY



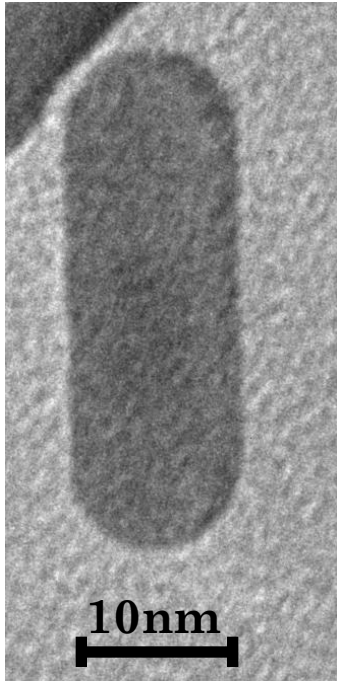
# OUTLINE:

- Synthesis of gold nanorods
- Transfer into organic solvents
- Thermogravimetric Analysis (TGA)
- Melting of gold nanorods upon irradiation with fs laser





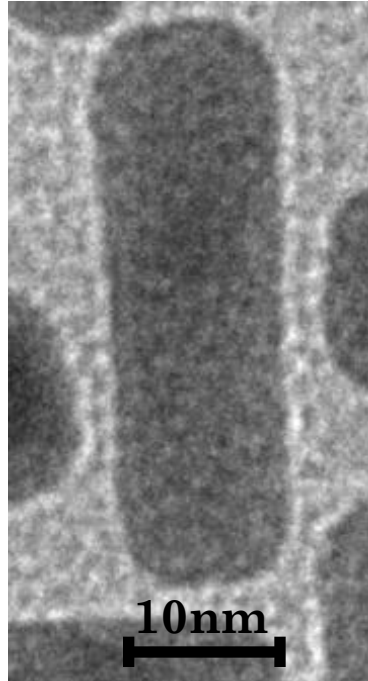
# INFLUENCE OF $\text{Na}_2\text{S}$ ON THE GOLD NANORODS STRUCTURE



29nm x 9nm

a.r.= 3.2

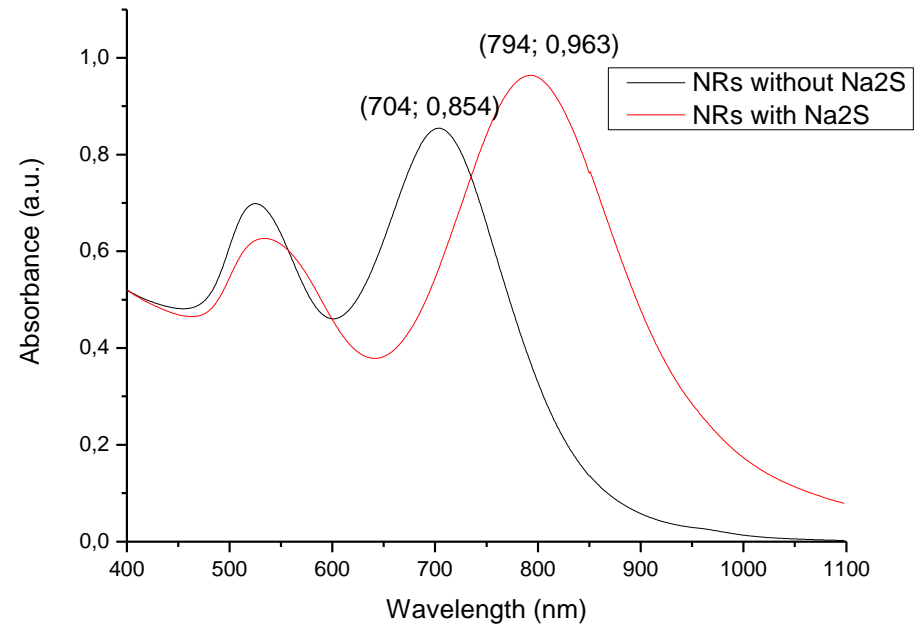
NRs without  $\text{Na}_2\text{S}$



35 nm x 10nm

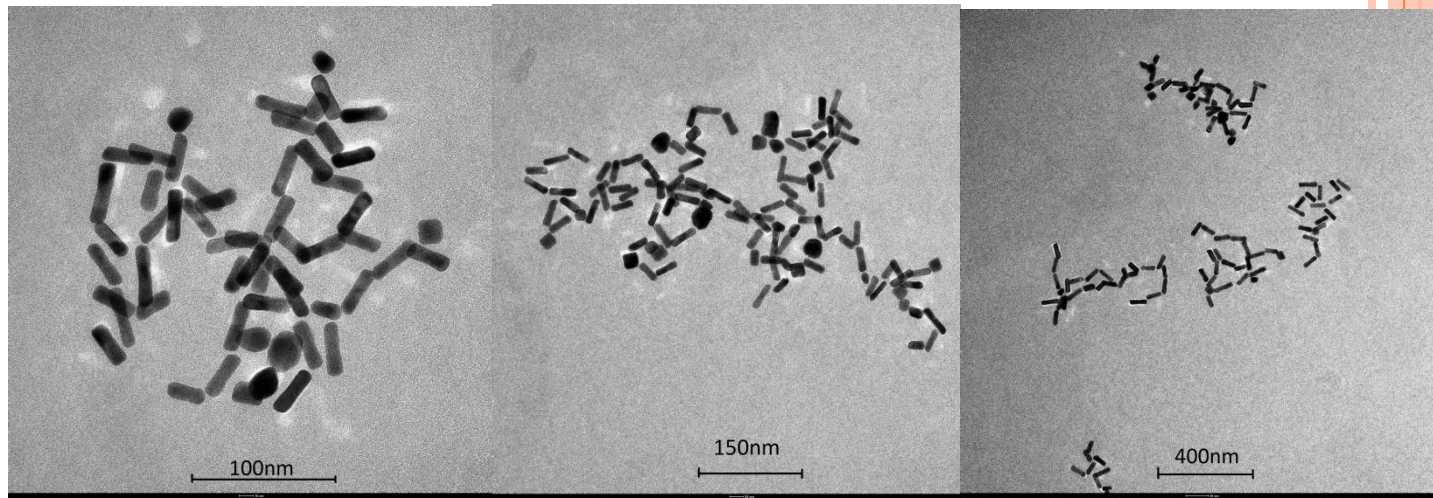
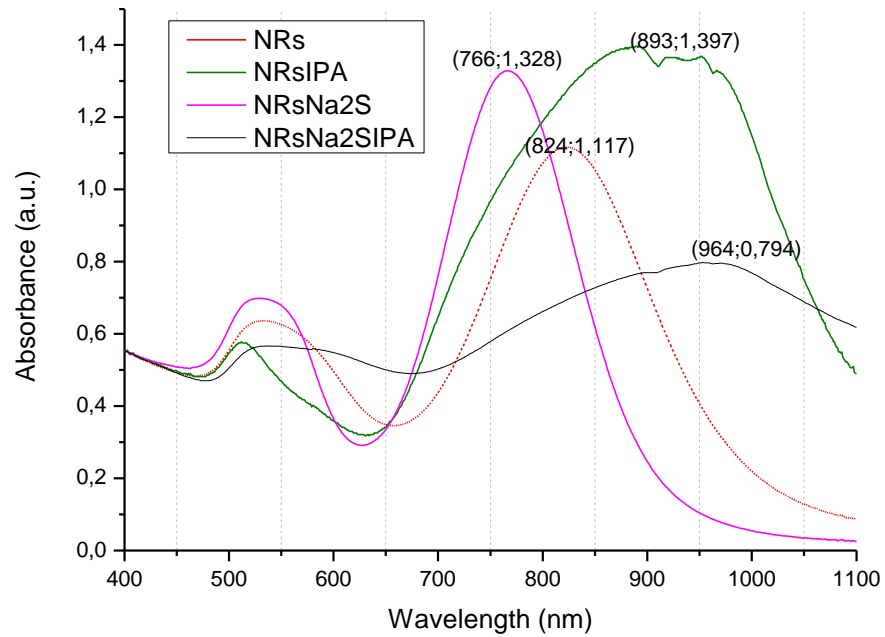
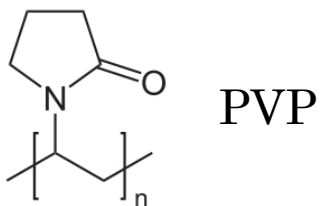
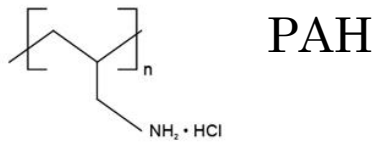
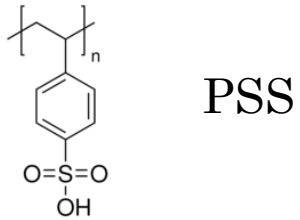
a.r.= 3.5

NRs with  $\text{Na}_2\text{S}$

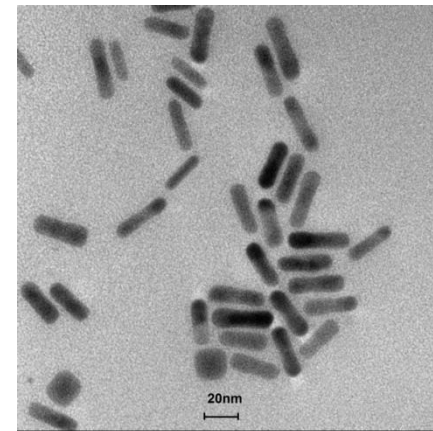
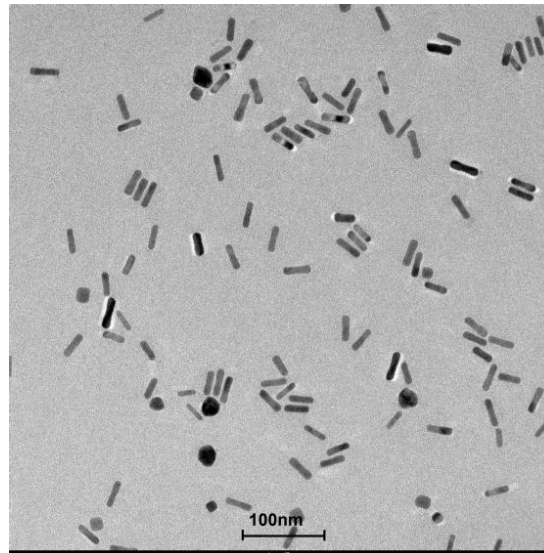
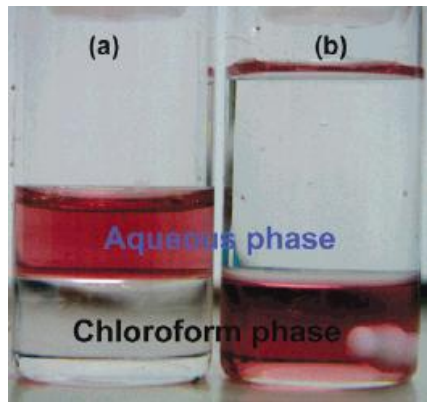
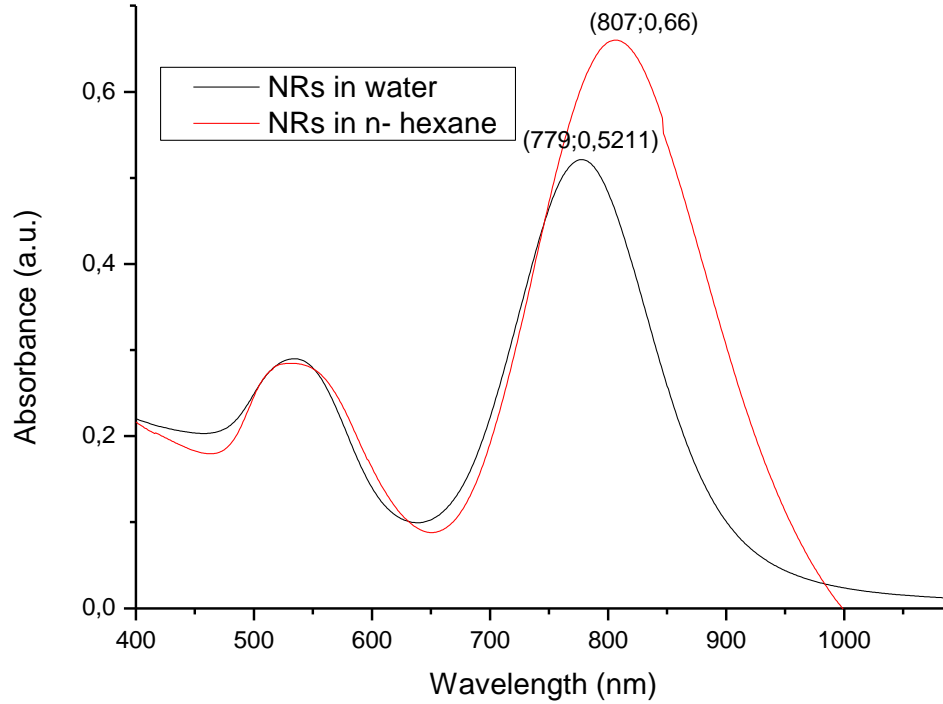
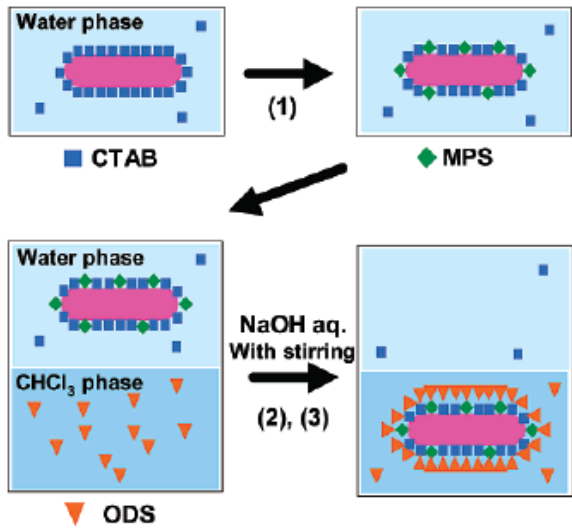


# GOLD NANORODS IN ISO-PROPANOL

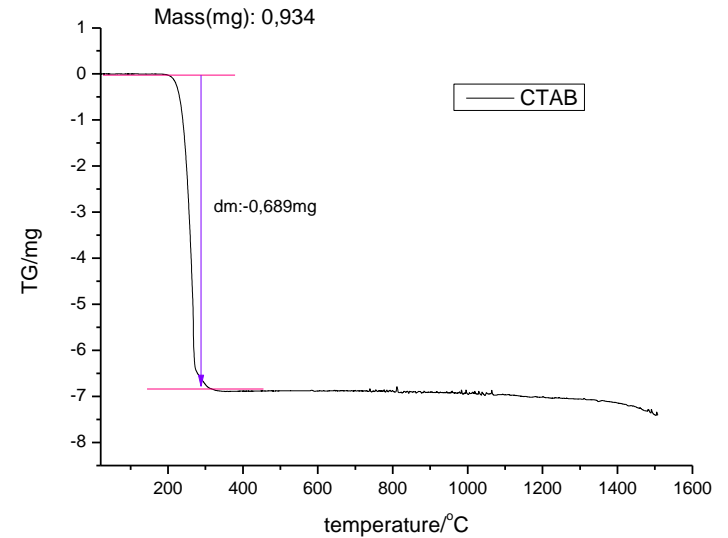
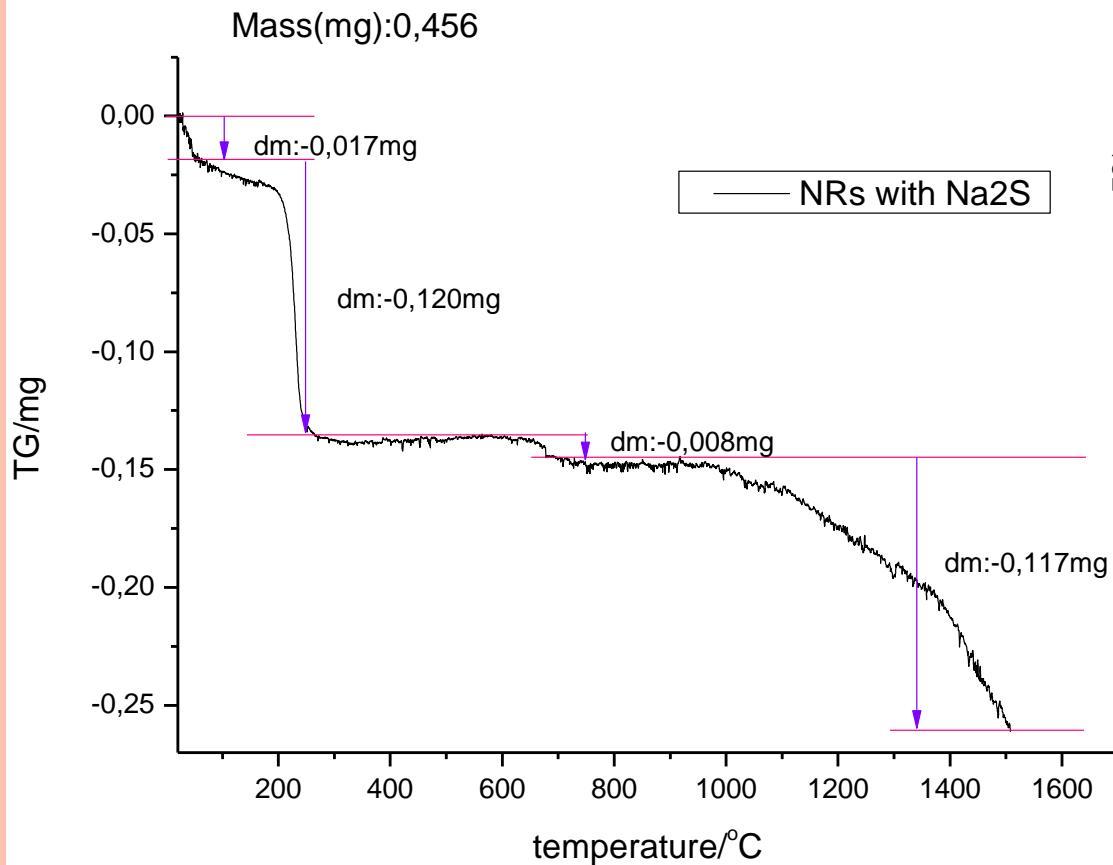
NRs@CTAB



# GOLD NANORODS IN N-HEXANE



# RESULTS OF THERMOGRAVIMETRIC ANALYSIS (TGA)

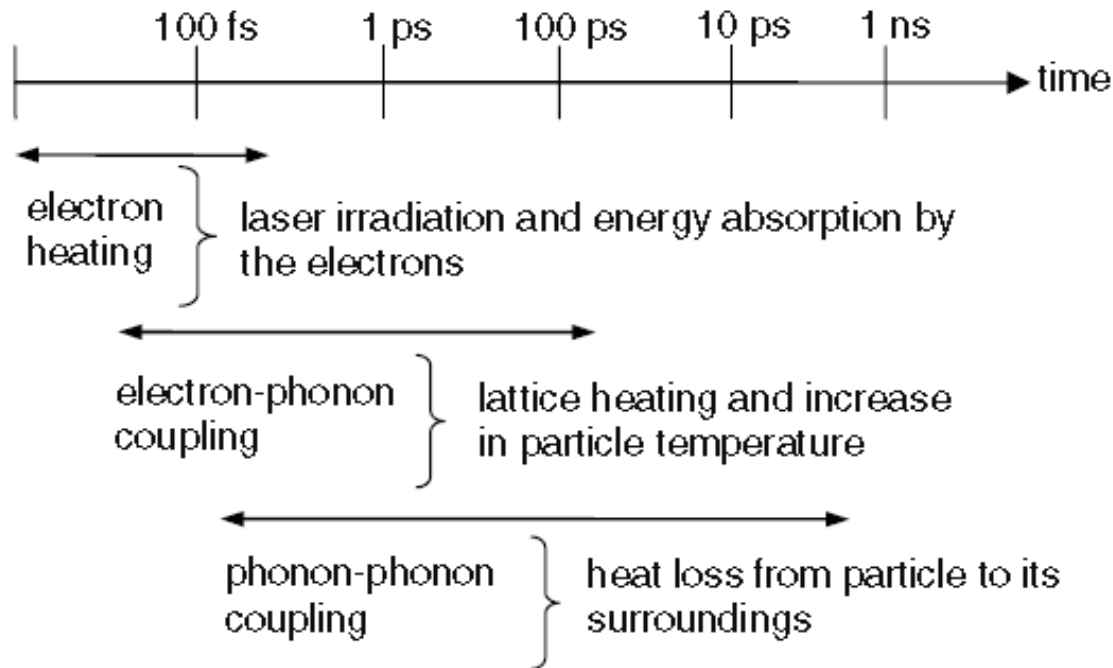




# MELTING OF GOLD NANORODS UPON IRRADIATION WITH FS LASER



# PROCESSES ASSOCIATED DURING ULTRAFAST LASER HEATING OF METAL NANOPARTICLES



**pulse repetition  
time: 1ms**



## STUDIED PARAMETERS:

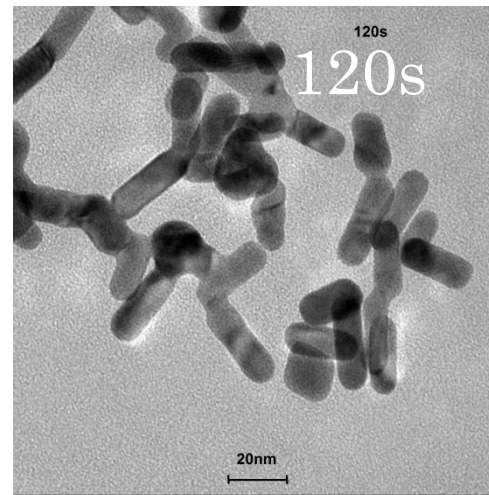
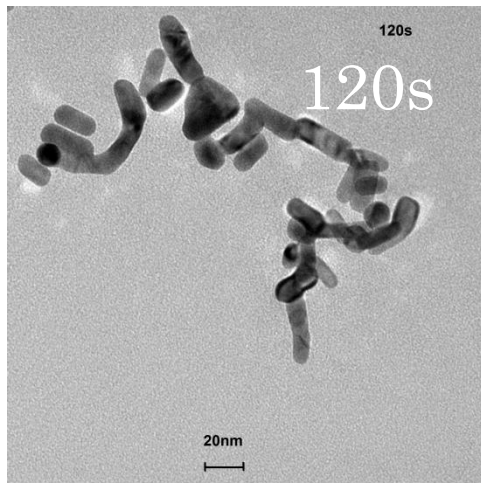
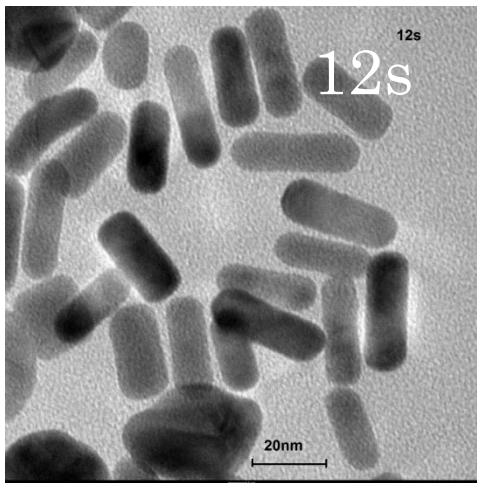
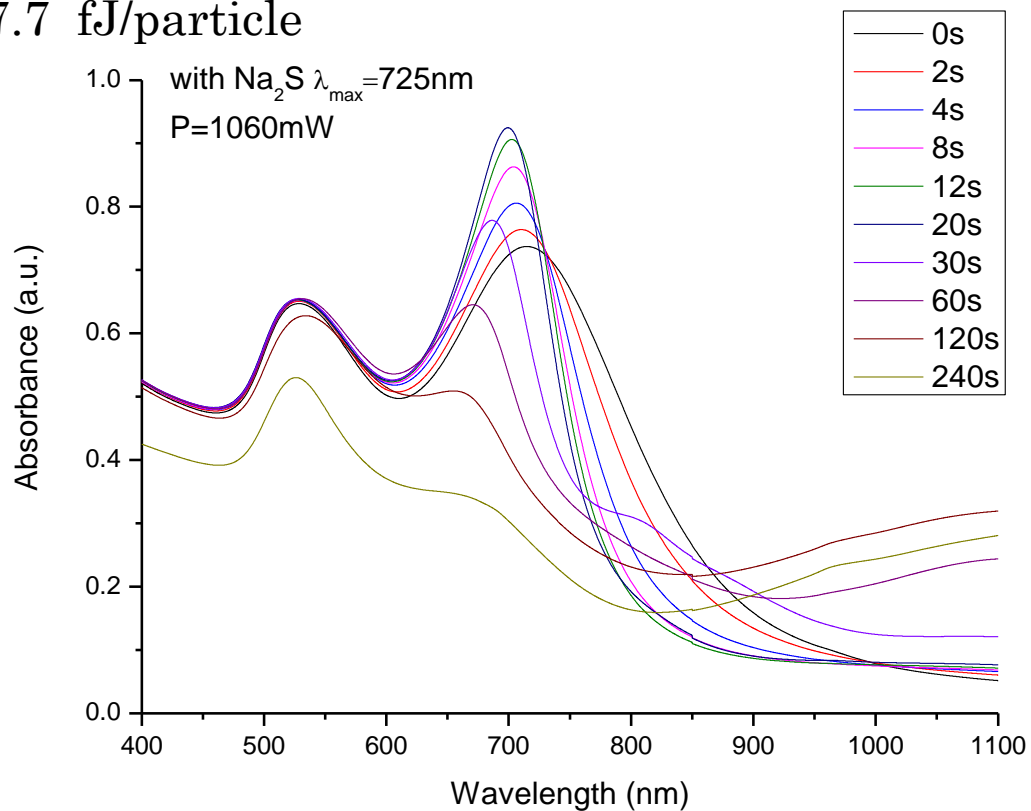
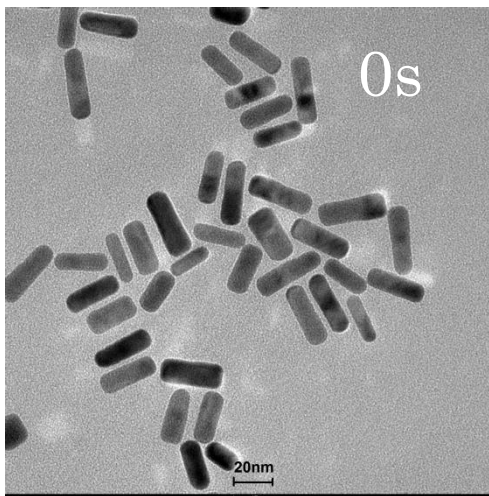
- Power of a laser beam
- Position of 1-SPR band
- Influence of  $\text{Na}_2\text{S}$  bound to the gold surface

A Quantronix Integra-C regenerative amplifier operating as a **800 nm** pump were used to deliver wavelength tunable pulses of **<130 fs**, with a repetition rate of **1 kHz**.

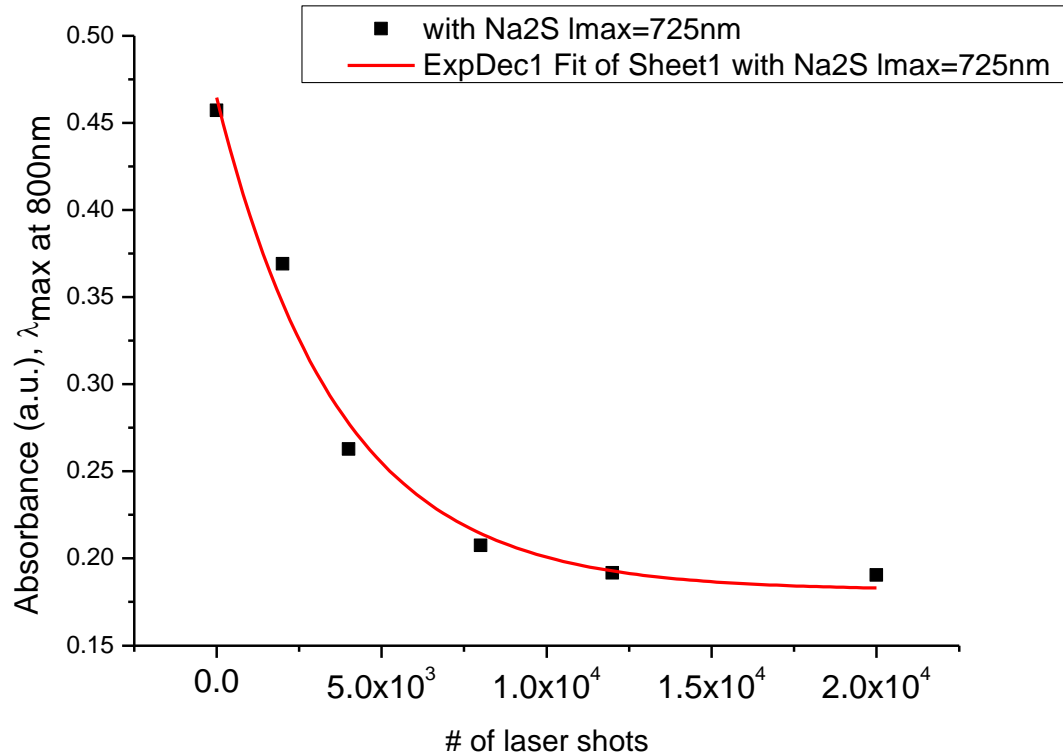


Energy per particle: 7.7 fJ/particle

Fluence = 3 mJ/cm<sup>2</sup>



P=1060mW



The time required to reduce the nanorod concentration to 1/e, as monitored by the absorption intensity at 800 nm

$\tau_{1/e}$ : 3.7s

no of leaser shots: 3701

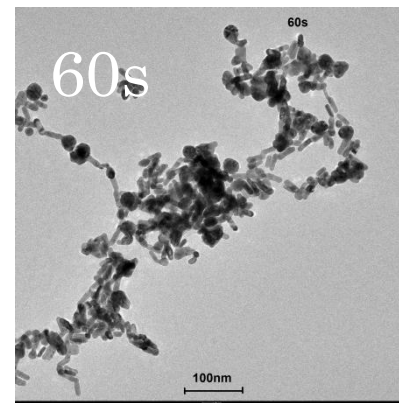
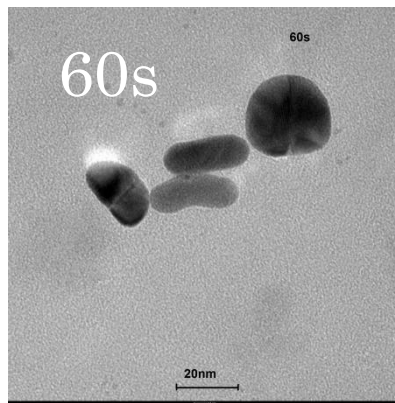
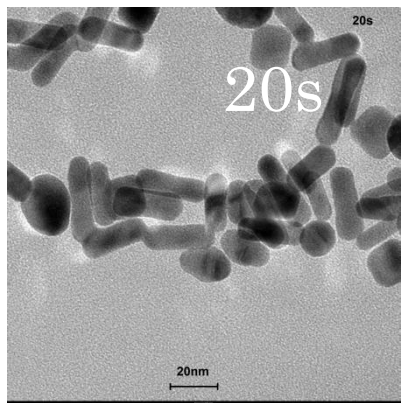
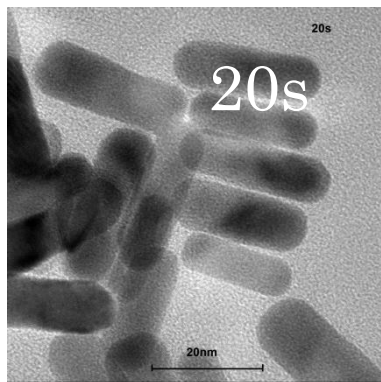
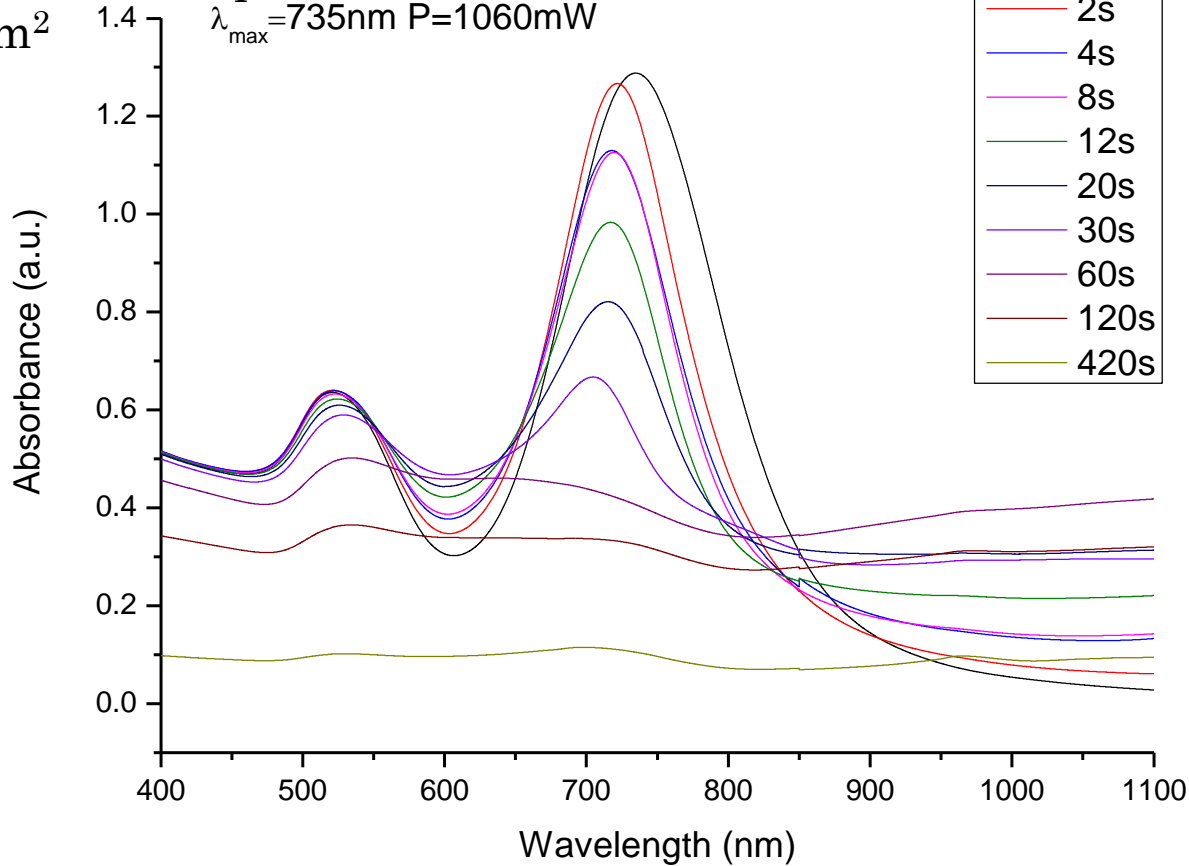
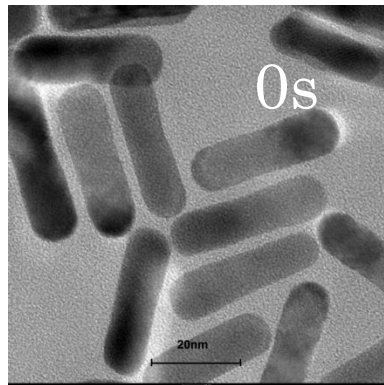
P=1.06 mJ/shot

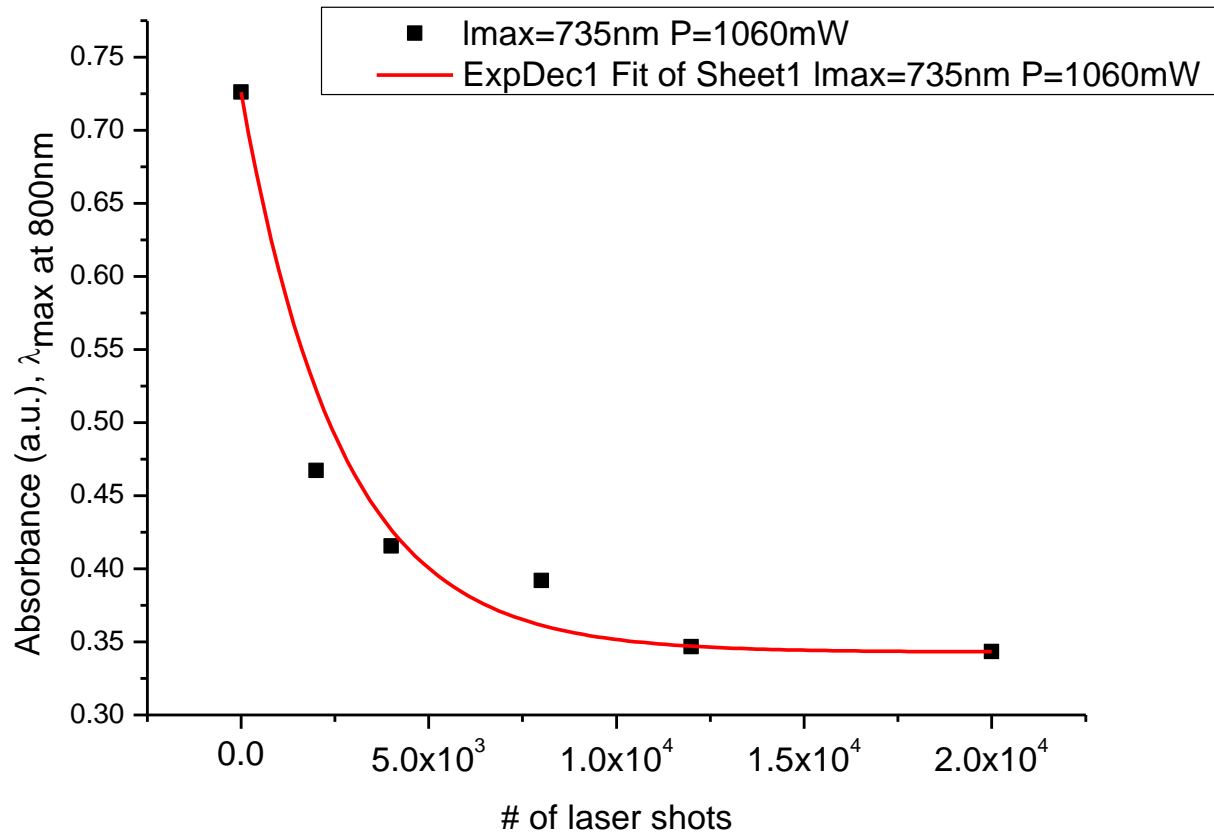


Energy per particle: 10.9 fJ/particle

Fluence=3.3 mJ/cm<sup>2</sup>

$\lambda_{\max}$ =735nm P=1060mW





The time required to reduce the nanorod concentration to  $1/e$ , as monitored by the absorption intensity at 800 nm

$\tau_{1/e}$  : 2.6 s

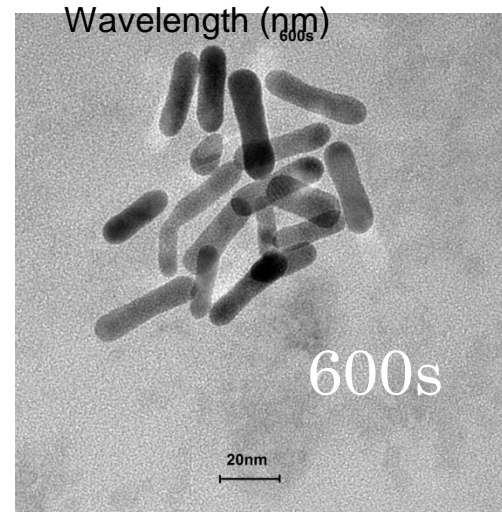
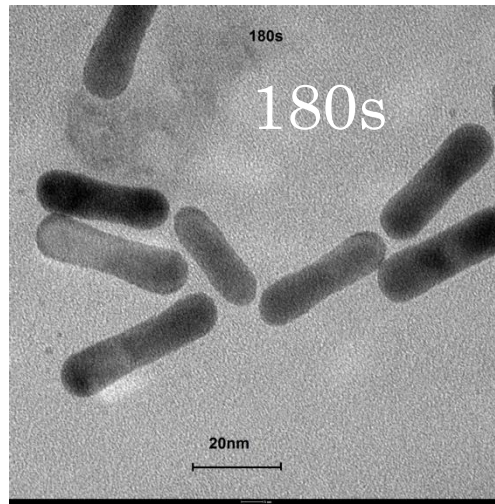
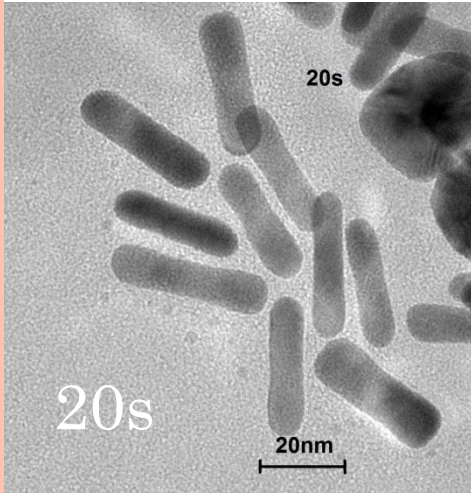
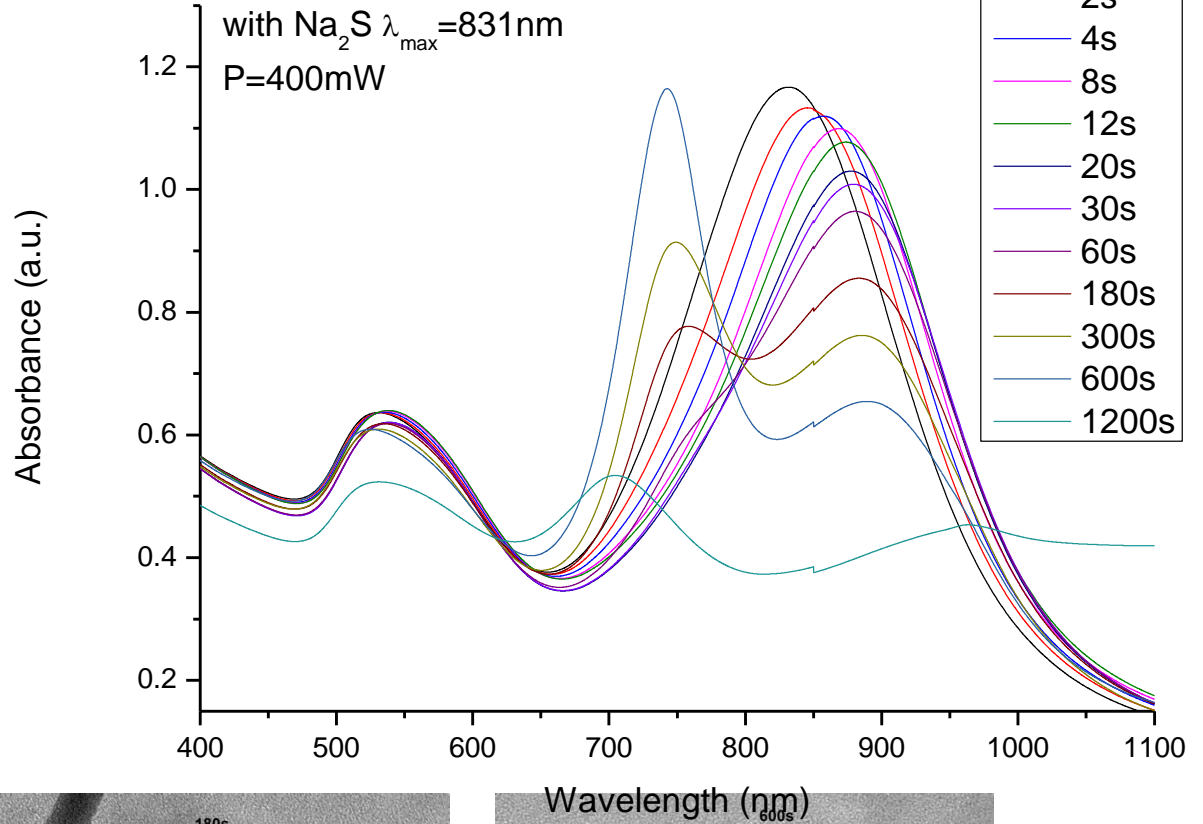
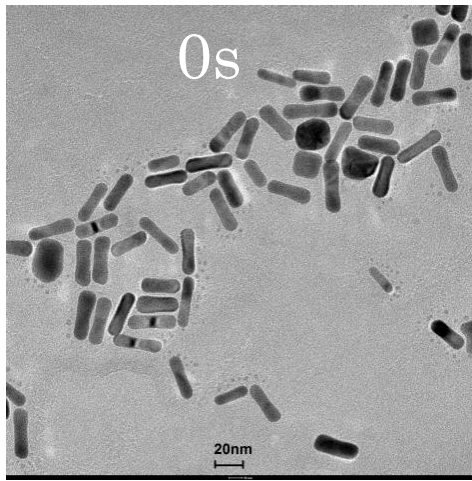
no of leaser shots: 2633

P=1.06 mJ/shot

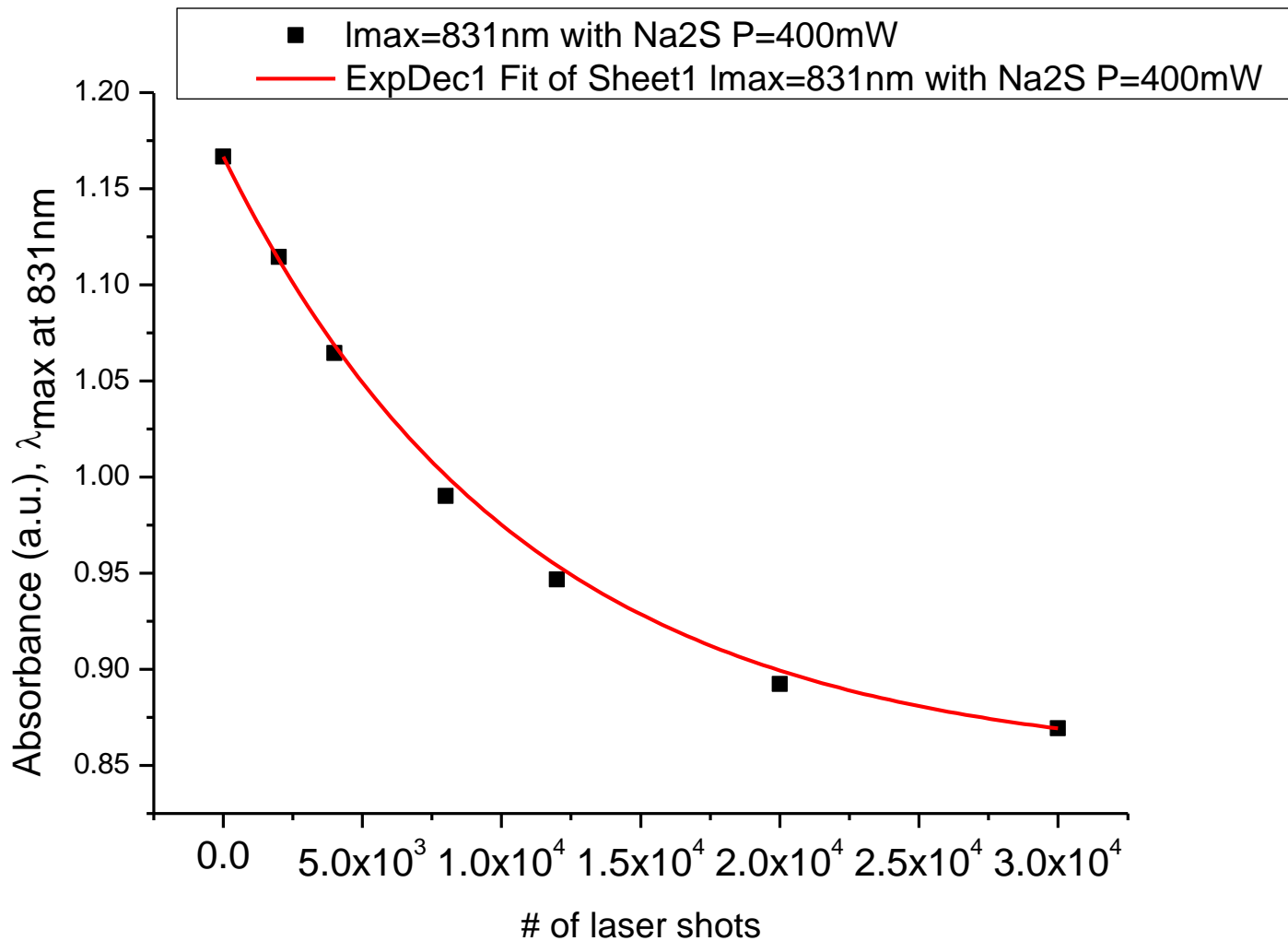


energy per particle: 2.7 fJ/particle

Fluence=3.3 mJ/cm<sup>2</sup>







The time required to reduce the nanorod concentration to  $1/e$ , as monitored by the absorption intensity at 831 nm

$\tau_{1/e}$ : 10.8 s

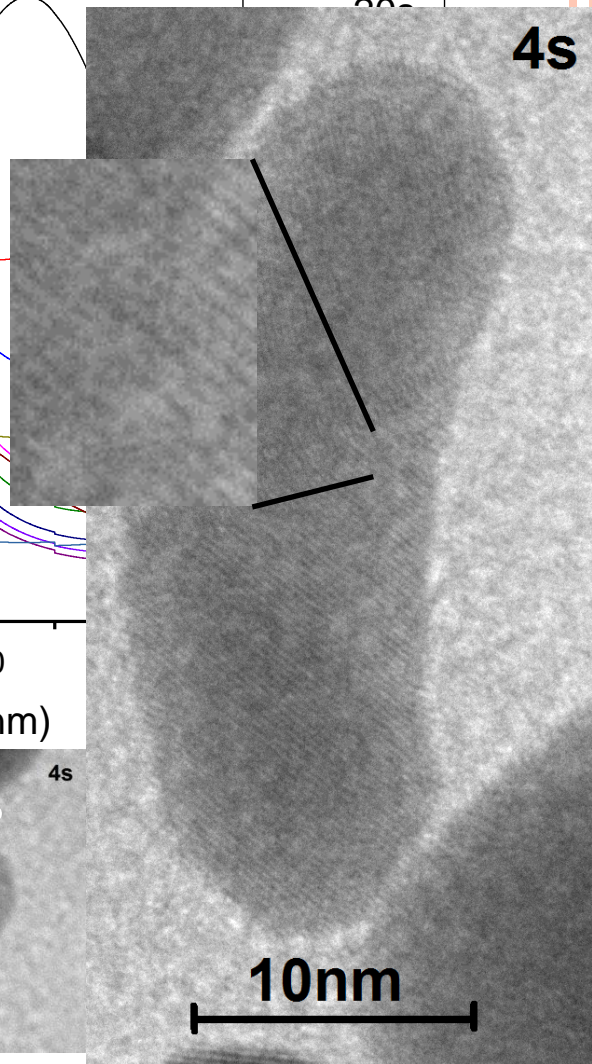
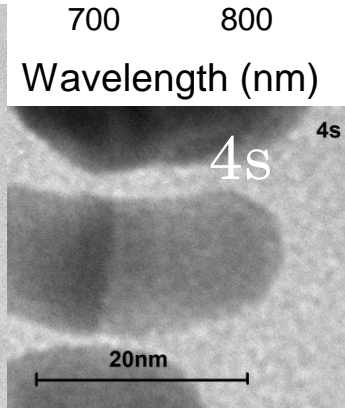
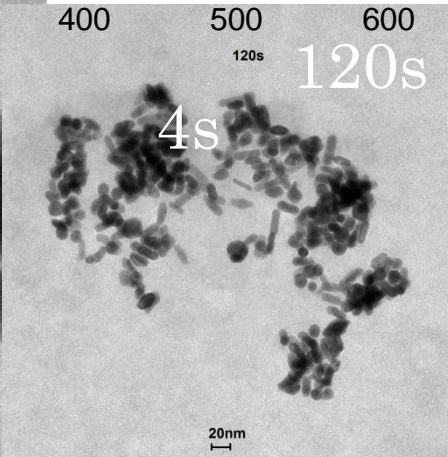
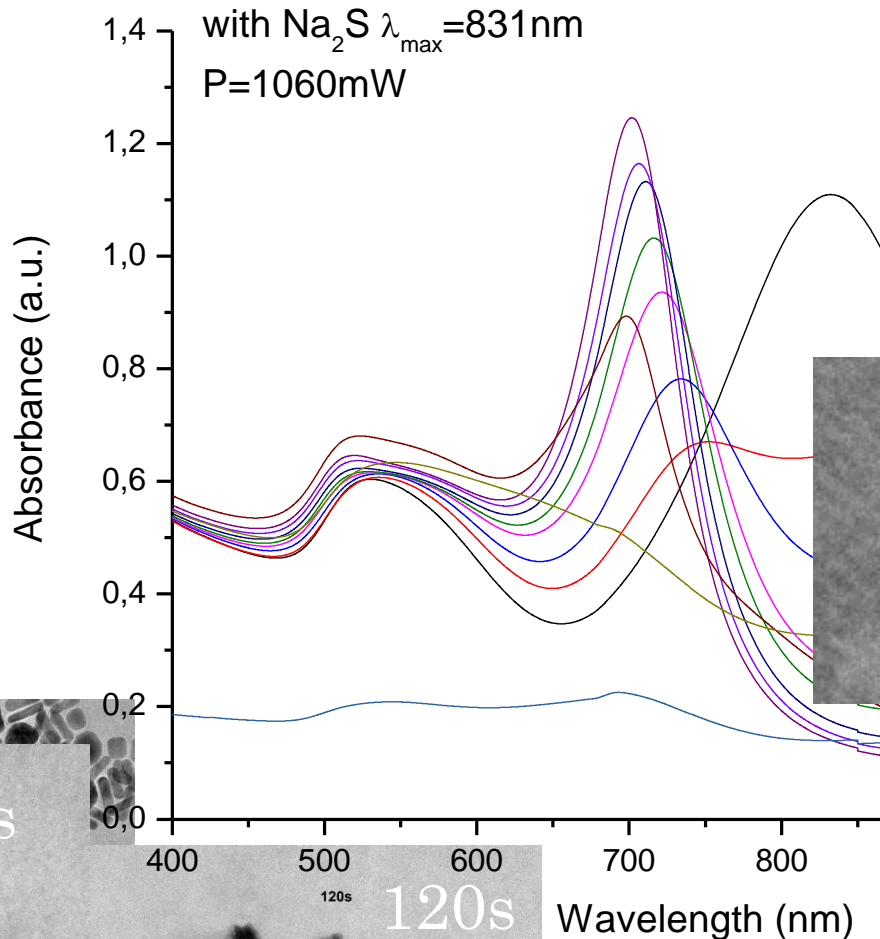
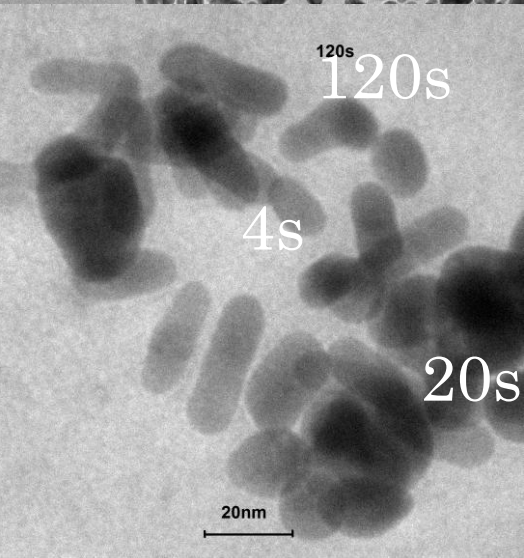
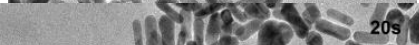
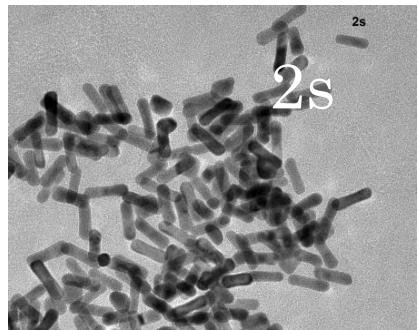
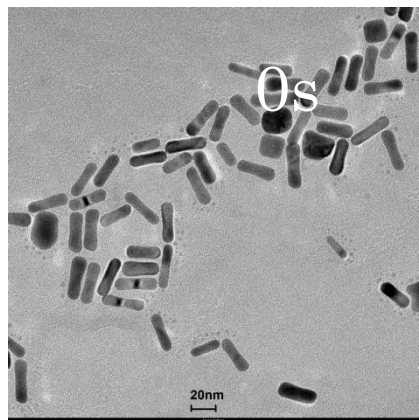
no of leaser shots: 10819

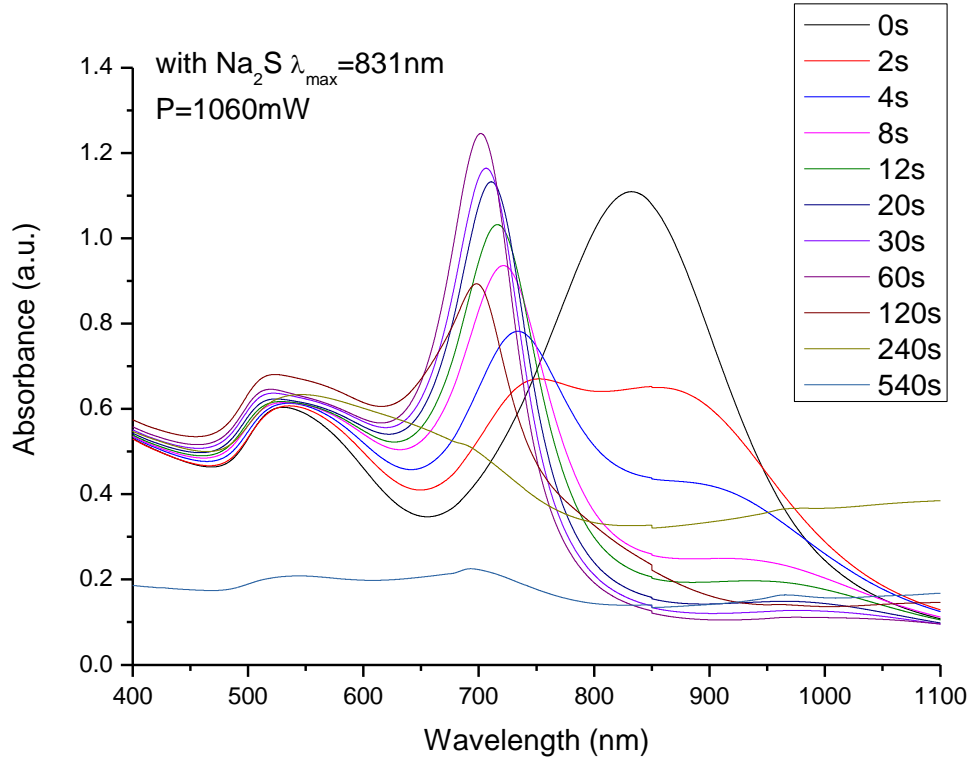
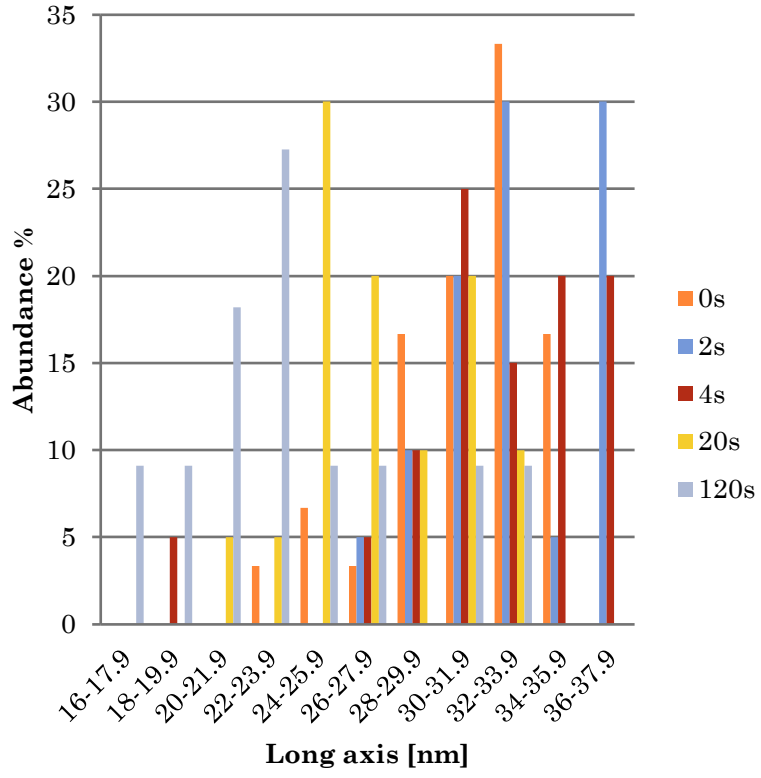
P=0.40 mJ/shot

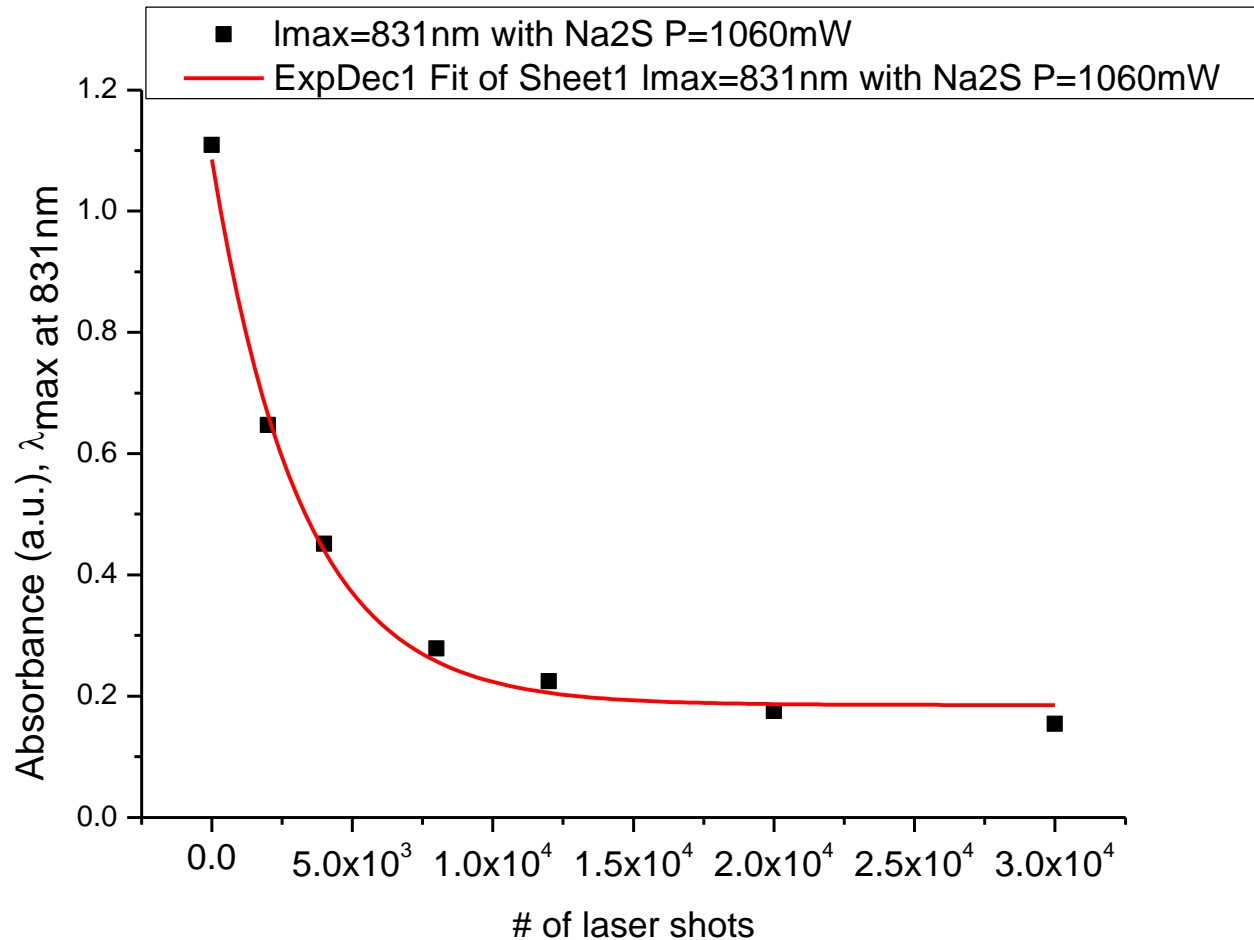


energy per particle: 6.7 fJ/particle

Fluence= 3.3 mJ/cm<sup>2</sup>







The time required to reduce the nanorod concentration to 1/e, as monitored by the absorption intensity at 831 nm

$\tau_{1/e}$  : 3.1 s

no of leaser shots: 3166

P=1,06 mJ/shot



# SUMMARY

- Power of a laser beam

	NRs $\lambda_{\max}$ =831 nm P=1060 mW with Na <sub>2</sub> S	NRs $\lambda_{\max}$ =831 nm P=400 mW with Na <sub>2</sub> S
no of leaser shots	<b>3166</b>	<b>10819</b>

- Position of l-SPR band

	NRs $\lambda_{\max}$ =725 nm P=1060 mW with Na <sub>2</sub> S	NRs $\lambda_{\max}$ =831nm P=1060 mW with Na <sub>2</sub> S
no of leaser shots	<b>3701</b>	<b>3166</b>

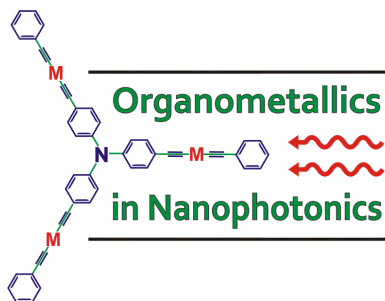
- Influence of Na<sub>2</sub>S bound to the gold surface

	NRs $\lambda_{\max}$ =735 nm P=1060 mW without Na <sub>2</sub> S	NRs $\lambda_{\max}$ =725 nm P=1060 mW with Na <sub>2</sub> S
no of leaser shots	<b>2633</b>	<b>3701</b>





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DEVELOPMENT FUND



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Prof. Marek Samoć

**THANK YOU FOR YOUR ATTENTION**

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