Plasmonic nanohybrids for vectorization and delivery of antisense oligonucleotides in metastatic melanoma models

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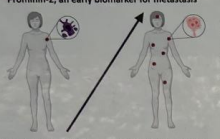
Introduction

Prominin-2, an early biomarker for metastasis[1]

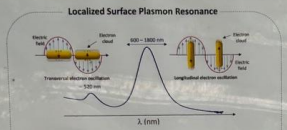


Low expression of PROM2
- ✓ Apoptosis
- No metastasis

High expression of PROM2
- ✗ Ferroptosis Resistance
- Metastasis

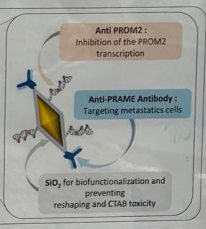
Antisens oligonucleotide (ASO) anti-PROM2 can decrease the expression of PROM2

Localized Surface Plasmon Resonance



- Anisotropic morphologies → Tunable LSPR
- LSPR in the Near Infrared → Biological window
- Local hyperthermia induced by a laser → Photothermal therapy

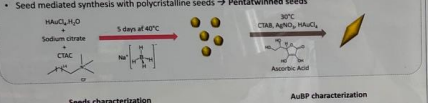
PTT



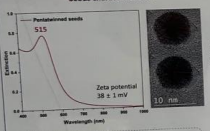
AuBP synthesis

Synthesis pathway[2]

- Seed mediated synthesis with polycristalline seeds → Pentatwinned seeds

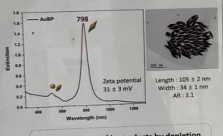


Seeds characterization



- ✓ Five twinning planes
- ✓ Colloidal stability and monodispersity

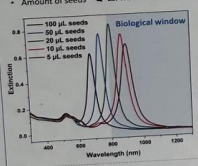
AuBP characterization

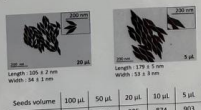


- ✓ Elimination of byproducts by depletion
- ✓ Colloidal stability

LSPR band variation study

- Amount of seeds ↘ LSPR band ↗ AuBP size ↗



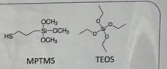


Seeds volume	100 µL	50 µL	20 µL	10 µL	5 µL
LSPR band (nm)	683	739	805	874	903
D_h (nm)	13 ± 1	15 ± 4	16 ± 1	29 ± 1	39 ± 1
Zeta (mV)	40 ± 3	43 ± 15	51 ± 14	44 ± 4	44 ± 4

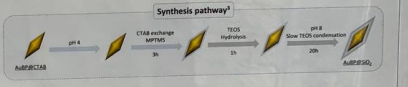
- ✓ Wide panel of AuBP sizes and sharpness
- ✓ Biological window reached

AuBP silica coating

- Thin silica layer → Maintain of AuBP sharpness

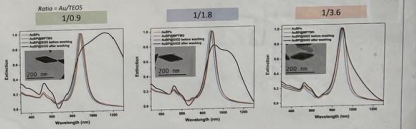


Synthesis pathway[3]



AuBP@SiO_2 characterization

- Amount of TEOS ↗ Silica thickness ↗



- Comparison of AuBP at different steps of the silica coating

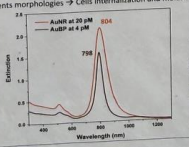
	AuBP@CTAB	AuBP@MPTMS	1/0.9		1/1.8		1/3.6	
			Before	After	Before	After	Before	After
LSPR band (nm)	911	875	886	Broad	890	Broad	894	882
Dh (nm)	38 ± 1	30 ± 1	33 ± 1	648 ± 20	38 ± 1	115 ± 7	46 ± 1	85 ± 1
Zeta potential (mV)	40 ± 3	33 ± 1	45 ± 2	-20 ± 1	46 ± 1	-26 ± 1	36 ± 1	-24 ± 1
Silica thickness (nm)	/	/	3.3 ± 0.7		6.4 ± 1.6		8.5 ± 1.4	

- ✓ Successful removal of CTAB
- ✓ Different silica thickness
- ✓ Sharpness of the tips preserved
- ✗ Low stability after washings steps
- ✗ Heterogeneity silica layer thickness

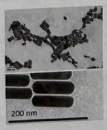
AuNR VS AuBP

Zeta potential = 31 ± 3 mV
Length : 105 ± 2 nm
Width : 34 ± 1 nm
AR : 3.1

- Higher monodispersity
- Higher molar extinction
- More hotspots
- Potentially better internalization



- Differents morphologies → Cells internalization and molar extinction



Zeta potential = 59 ± 2 mV
Length : 106 ± 6 nm
Width : 31 ± 2 nm
AR : 3.4

- Higher stability
- Less meticulous synthesis
- Thin silica coating already established in litterature

Conclusions and perspectives

- AuBP size and LSPR control
- Preliminary results on silica thickness investigation
- Comparative study between CTAB stabilized AuNR and AuBP

- Enhance silica coating stability and homogeneity
- Biofunctionalization of AuBP@SiO_2
- Comparing nanohybrids performances under laser radiation

References

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[2] Sánchez-Iglesias, A., Winckelmans, N., Altantzis, T., Bals, S., Grzelczak, M., Liz-Marzán, L. M. « High-Yield Seeded Growth of Monodisperse Pentatwinned Gold Nanoparticles through Thermally Induced Seed Twinning ». J. Am. Chem. Soc., 2017.

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