

# Interaction of Glutamic acid and/or Glutamine with three different types of Ag nanoparticles

Hana Kubičková Dept. of Experimental Physics Palacky University Olomouc

#### AgBh— Nanoparticles solution prepared by chemical reduction driven by borohydride



Regional Centre of Advanced Technologies and Materials Dept. of Physical Chemistry Palacky University Olomouc

Zeta Potential Distribution

0

Zeta Potential (mV)



#### G 1— Nanoparticles solution prepared by chemical reduction driven by glucose



1000

10

#### Nanoparticles prepared by borohydride



#### Nanoparticles prepared by reduction using glucose





#### M 1— Nanoparticles solution prepared by chemical reduction driven by maltose







#### M 1— diluted







#### Nanoparticles prepared by reduction using maltose



System +	Size distribution				
glutamic acid	Intensity /nm	Number /nm	Volume /nm	/nm	
AgbhH	64 (79%) 10 (16%)	2 (100%)	10 (9%) 2 (91%)	32,5	
Agbh +2 μl	1758 (100%)	624 (100%)	2552 (100%)	1070	
Agbh +20 µl	511 (100%)	154 (100%)	767 (100%)	305	
Agbh +200 µl	118 (100%)	14 (100%)	23 (100%)	64	

Sustam .	Siz	Average		
glutamic acid	Intensity /nm	Number /nm	Volume /nm	size /nm
G 1	61 (94%) 11 (6%)	36 (1%) 9 (99%)	46 (15%) 10 (85%)	58,0
G 1 diluted	92 (97%)	11 (100%)	20 (98%)	66,9
G 1 diluted +2 μl	164 (90%) 20 (9%)	14 (100%)	28 (98%)	88,4
G 1 diluted +20 μl	94 (91%) 18 (9%)	14 (100%)	22 (100%)	61,8
G 1 diluted +200 µl	430 (90%) 5026 (6%) 57 (4%)	45 (99%)	559 (46%) 5175(46%) 50 (8%)	354

System +	Siz	Size distribution		
glutamic acid	Intensity /nm	Number /nm	Volume /nm	size /nm
M 1	56 (91%), 1690 (9%)	20 (100%)	28 (98%), 2568 (2%)	44, 2
M1 diluted	36 (100%)	20 (100%)	26 (100%)	31,7
M 1 diluted +2 μl	35 (100%)	21 (100%)	26 (100%)	31,7
M 1 diluted +20 µl	34 (100%)	23 (100%)	27 (100%)	31,7
M 1 diluted +200 µl	43 (89%) 937 (11%)	20 (100%)	26 (99%) 1161 (1%)	37,5
M 1 diluted +400 µl	72 (98%) 4632 (2%)	15 (100%)	24 (98%) 4899 (2%)	48

Siz	Average		
Intensity /nm	Number /nm	Volume /nm	size /nm
64 (79%) 10 (16%)	2 (100%)	10 (9%) 2 (91%)	32,5
67 (82%) 6 (16%)	3,5 (100%)	4,3 (99%) 32 (1%)	29,9
503 (98,5%)	382(100%)	610 (82%) 5448(18%)	392,4
455 (94%) 73 (4%) 5174 (2%)	54 (96%) 305 (4%)	359 (66%) 65 (6%) 5283(28%)	358,9
Į	Intensity /nm 64 (79%) 10 (16%) 67 (82%) 6 (16%) 503 (98,5%) 455 (94%) 73 (4%) 5174 (2%)	Intensity /nm Number /nm   64 (79%) 2 (100%)   10 (16%) 2 (100%)   67 (82%) 3,5 (100%)   6 (16%) 382(100%)   503 (98,5%) 382(100%)   455 (94%) 54 (96%)   73 (4%) 305 (4%)   5174 (2%) 54	Intensity /nm Number /nm Volume /nm   64 (79%) 2 (100%) 10 (9%)   10 (16%) 2 (91%)   67 (82%) 3,5 (100%) 4,3 (99%)   6 (16%) 32 (1%)   503 (98,5%) 382(100%) 610 (82%)   5448(18%) 5448(18%)   455 (94%) 54 (96%) 359 (66%)   73 (4%) 305 (4%) 65 (6%)   5174 (2%) 5283(28%)

	/nm	/nm	/nm	
M1	56 (91%), 1690 (9%)	20 (100%)	28 (98%), 2568 (2%)	44, 2
M 1 diluted	36 (100%)	20 (100%)	26 (100%)	31,7
M 1 diluted +2 μl	49 (89%) 1406 (11%)	23 (100%)	31 (97%) 2326 (2%)	42,9
M 1 diluted +20 µl	37 (100%)	21 (100%)	27 (100%)	32,5
M 1 diluted +200 µl	38 (97%) 4652 (3%)	20 (100%)	26 (98%) 4914 (2%)	33,2
M 1 diluted +400 μl	38 (99%) 4689 (1%)	20 (100%)	26 (99%) 4937 (1%)	31,5

Size distribution

Intensity Number Volume

Average size

Systém+		Zeta potential					
glutamine	0 μL	0 μL	2 μL	20 µL	200 μL	400 μL	600 μL
Agbh	-27,4 (99%)		-23,4 (100%)	-17,5 (100%)	-16,1 (100%)		
G 1	-33,9 (95%) 1,1 (3%) 17,5 (1%)	diluted: -36,9 (99%)	diluted: +6,9 (8%),- 32,2 (91%)	diluted: -7,8 (30%) -37,3 (70%)	diluted: -5,0 (75%) -30,0 (25%)	diluted: -7,9 (100%)	diluted: -10,2 (100%)
M 1	-28,1 (35%), -4,6 (28%), 15,1 (10%)	diluted: -42,9 (58%) -13,3 (34%) 13,4 (3%)	diluted: -37,6 (24%) -22,8 (15%) -1,9 (39%)	diluted: -26,0 (61%) - 52,9 (19%) -0,7 (10%)	diluted: -31,4 (56%) -10,0 (42%) -71,0 (2%)	diluted: -18,5 (100%)	

Curata ma	Siz	Size distribution			
System+ Glutamine	Intensity /nm	Number /nm	Volume /nm	size /nm	
G1	61 (94%) 11 (6%)	36 (1%) 9 (99%)	46 (15%) 10 (85%)	58,0	
G 1 diluted	92 (97%)	11 (100%)	20 (98%)	66,9	
G 1 diluted +2 µl	80 (100%) 20 (9%)	12 (100%)	21 (100%)	57,3	
G 1 diluted +20 μl	120 (99%) 4311 (1%)	13 (100%) 23 (99%) 4691 (1%)		69,3	
G 1 diluted +200 µl	110 (89%) 20 (9 %) 5388 (1%)	6 (100%) 78 (4%) 16 (30%) 5450 (1%)		82,7	
G 1 diluted +400 µl	127 (98%) 5364 (2%)	22 (100%)	41 (93%) 5429 (7%)	96,2	
G 1 diluted +600 µl	113 (90%) 16 (9%) 5383 (1%)	13 (100%)	82 (7%) 15 (91%) 5446 (2%)	86	

Suctóm	Zeta p	ootential				
glutamic acid	0 μL	0 μL	2 μL	20 µL	200 µL	400 μL
Agbh	-27,4 (99%)		+0,2 (100%)	+16,3 (100%)	+16,4 (96%) -32 (3%)	
G 1	-33,9 (95%) 1,1 (3%) 17,5 (1%)	diluted: -36,9 (99%)	diluted: -9,9 (50%) -30,8 (49%)	diluted: -12,9 (54%) -31,5 (46%)	diluted: -13,1(100%)	
M 1	-28,1 (35%) -4,6 (28%) 15,1 (10%)	diluted: -42,9 (58%) -13,3 (34%) 13,4 (3%)	diluted: -34,6 (77%) -8,8 (17%) +7,4 (4%)	diluted: -28,5 (26%) -9,5 (32%) +8,3 (13%)	diluted: -15,6(99%) -86,6(99%)	diluted: -11,8(94%) -48,0(4%)



## Glutamic acid + Ag nanoparticles





Glutamine + Ag nanoparticles









MINISTRY OF EDUCATION, YOUTH AND SPORTS



INVESTMENTS

IN EDUCATION

DEVELOPMENT

**OP Education** for Competitiveness

#### Acknowledgement: Dr. Klára Šafářová is thanked for TEM imaging. Financial support by P108/11/P657 Grant awarded by GACR, by the project entitled "Education of Scientists in the Regional Centre of Advanced technologies and Materials" (CZ.1.07/2.3.00/09.0042), and by the project entitled "New technologies in applied physics" (CZ.1.07/2.2.00/07.0018) is gratefully acknowledged.



# Wavelength (nm)

### Outlook:

Surface enhanced Raman scattering and FT-IR absorption measurements of Ag nanoparticles + glutamic acid and/or glutamine in order to determine the type of interaction (ionic, covalent ...)







— 32 s —— 36 s

—— 40 s 

----- 120 s ----- 180 s

----- 200 s

Instrumentation: TEM = transmission electron microscopy DLS = dynamic light scattering UV -vis absorption spectroscopy  $\xi$  –potential measurements