Table 1. Nebulizers, ICP-OES and MIP-OES operating conditions

	Integra XL	JY 138	MIP 750 MV
Incident power / W	1300	1000	300
Argon flow rates / L min^{-1}			
- nebulizer gas	0.6	0.35	0.4
- auxiliary gas	0.4	0.15	-
- plasma gas	10.0	12.0	-
Sample flow rate / ml min^{-1}			
- concentric nebulizer	1.5	1.0	1.0
- NAR-1 nebulizer	0.2	0.1	0.1
Integration time / s	0.5	0.5	0.5

Element	Wavelength / nm
Al (I)	396.15
Cd (I)	228.80
Cd (II)	226.50
Mg (I)	285.21
Mg (II)	279.55
Zn (I)	213.86
Zn (II)	202.55
Cu (I)	324.75
Cu (II)	224.70
Mn (II)	257.61
Fe (II)	238.20
Hg (I)	253.65
Ni (I)	232.00
Mg (II)	280.20 (for Mg test)

Table 2. Comparison of analytical performance of NAR-1 and CCN by Integra XL ICP-OES (robust conditions)

Element	SBR		RSD (%)		BEC (ppm)	
	NAR-1	CCN	NAR-1	CCN	NAR-1	CCN
Al (I)	20.2	12.4	1.7	0.9	1.1	1.6
Cd (I)	38	46	1.1	1.8	0.03	0.04
Cd (II)	26	45	0.64	1.2	0.03	0.04
Mg (I)	30	20	0.8	0.5	0.03	0.05
Mg (II)	156	98	1.4	0.9	0.006	0.01
Zn (I)	435	52.5	1.9	2.0	0.004	0.04
Zn (II)	200	150	1.0	0.8	0.004	0.01
Cu (I)	85	29	1.8	2.4	0.12	0.35
Cu (II)	40	41	1.9	1.5	0.24	0.24
Mn (II)	67	131	2.5	3.0	0.01	0.008
Fe (II)	44	90	1.6	2.2	0.1	0.04

]

Table 3. Comparison of analytical performance of NAR-1 and TR50C1 nebulizers by JY 138 ICP-OES

Element	Concentric		NAR-1	
	DL [ng mL^{-1}]	RSD [%]	DL [ng mL^{-1}]	RSD [%]
Zn (I)	0.81	1.9	0.33	0.5
Cd (I)	0.48	16.9	0.55	3.4
Fe (II)	1.24	9.5	0.32	1.8
Mg (II)	0.29	2.4	0.35	3.9
Cu (I)	1.01	4.7	0.92	1.5

Table 4. Comparison of detection limits [ng ml^{-1}] by NAR-1 and MCA nebulizers by MIP-OES

Element	NAR-1 (this work)	MCA (this work)	NAR-1 [8]
Cd (I)	11	9	28*
Cu (I)	10	20	8
Fe (II)	51	87	62
Hg (I)	32	45	-
Mn (II)	6	30	6
Ni (I)	49	95	-
Zn (I)	8	15	8

* - for Cd (II)

Tab.5. Stoichiometric analysis of nanocristalline Li/Mn spinels by MIP-OES

Nominal composition *x* in $Li_{1+x}Mn_{2-x}O_4$	Total Mn content (mol/formula)		Effective *x* in spinel phase
	nominal	experimental	
0	2.0	1.98	0.00 ± 0.03
0.05	1.95	1.94	0.05 ± 0.03
0.10	1.90	1.86	0.17 ± 0.03
0.15	1.85	1.82	0.20 ± 0.03
0.20	1.80	1.77	0.23 ± 0.03
0.25	1.75	1.77	0.23 ± 0.03
0.30	1.70	1.72	0.28 ± 0.03
0.33	1.67	1.65	0.38 ± 0.04

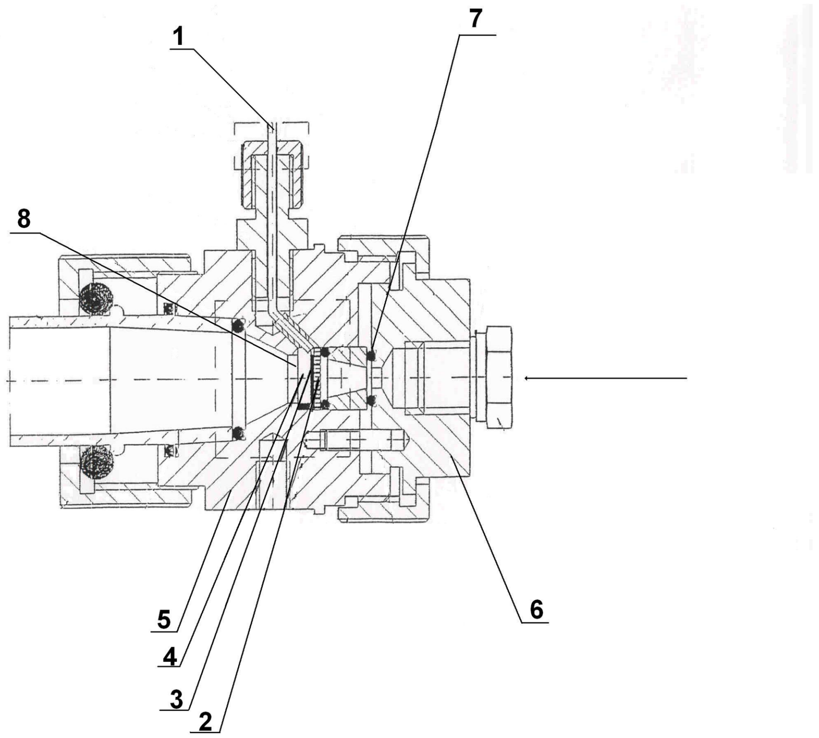


Fig. 1. The NAR-1 design

1 – analyte inlet
2 – microcapillary array plate
3 – sheet silicone seal
4 – alumina mask with interchangeable slit width
5,6 – nebulizer body
7 – silicone o-rings

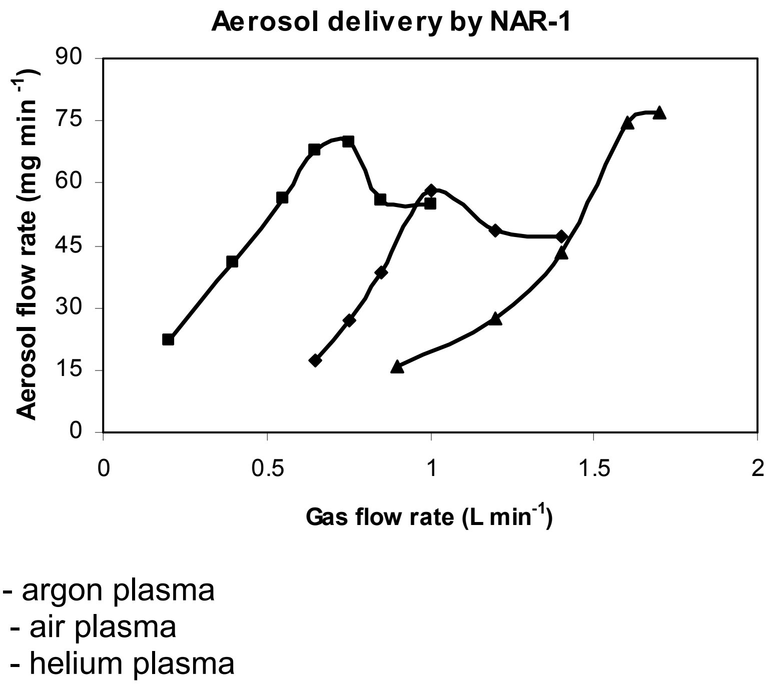


Fig. 2. The effect of nebulizer gas flow rate for argon, air and helium on aerosol flow rate produced by NAR-1 at 0.2 ml min^{-1} water consumption rate.

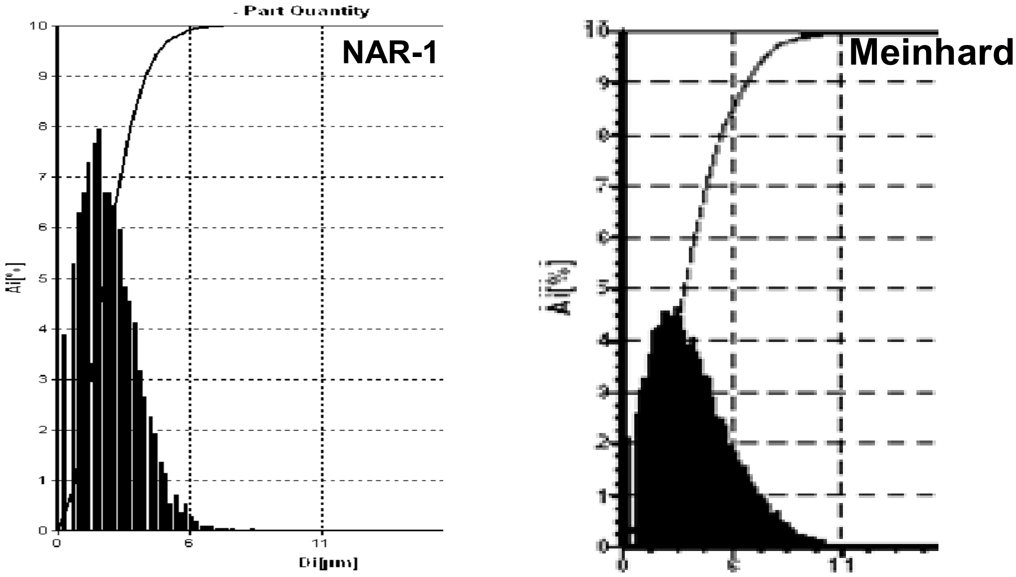
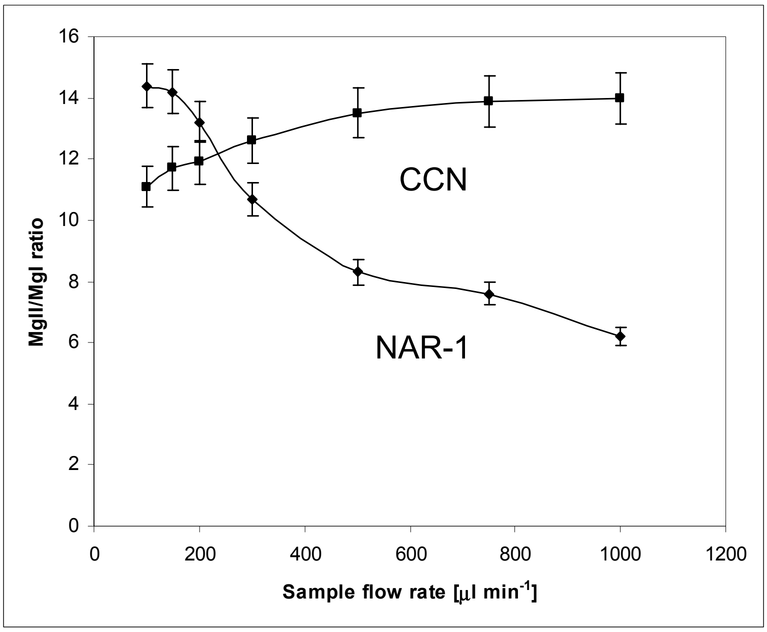


Fig. 3. The drop size distribution of tertiary aerosol obtained by NAR-1 and Meinhard nebulizers.

a) Integra XL ICP-OES



b) JY 138

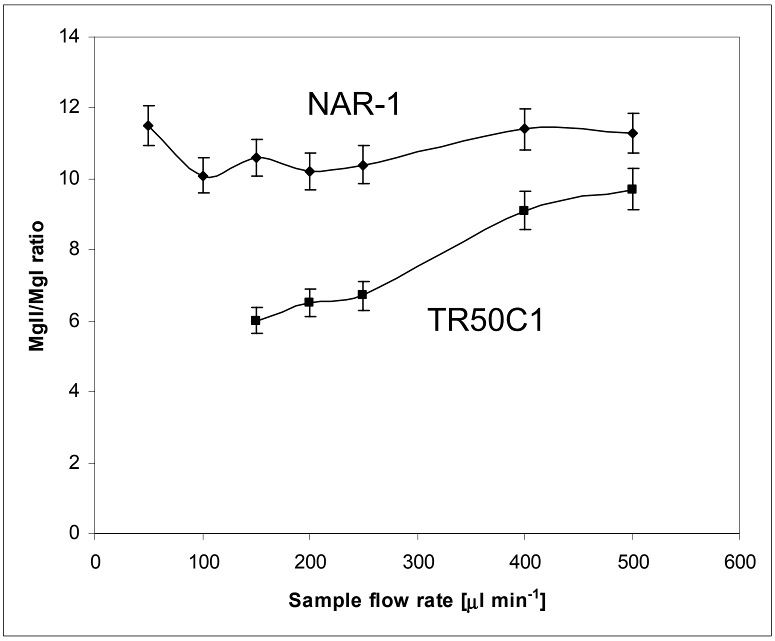


Fig. 4. The effect of sample flow rate on MgII/MgI ratio for ICP-OES systems with NAR-1 and CN (a – for Integra XL; b – for JY 138).

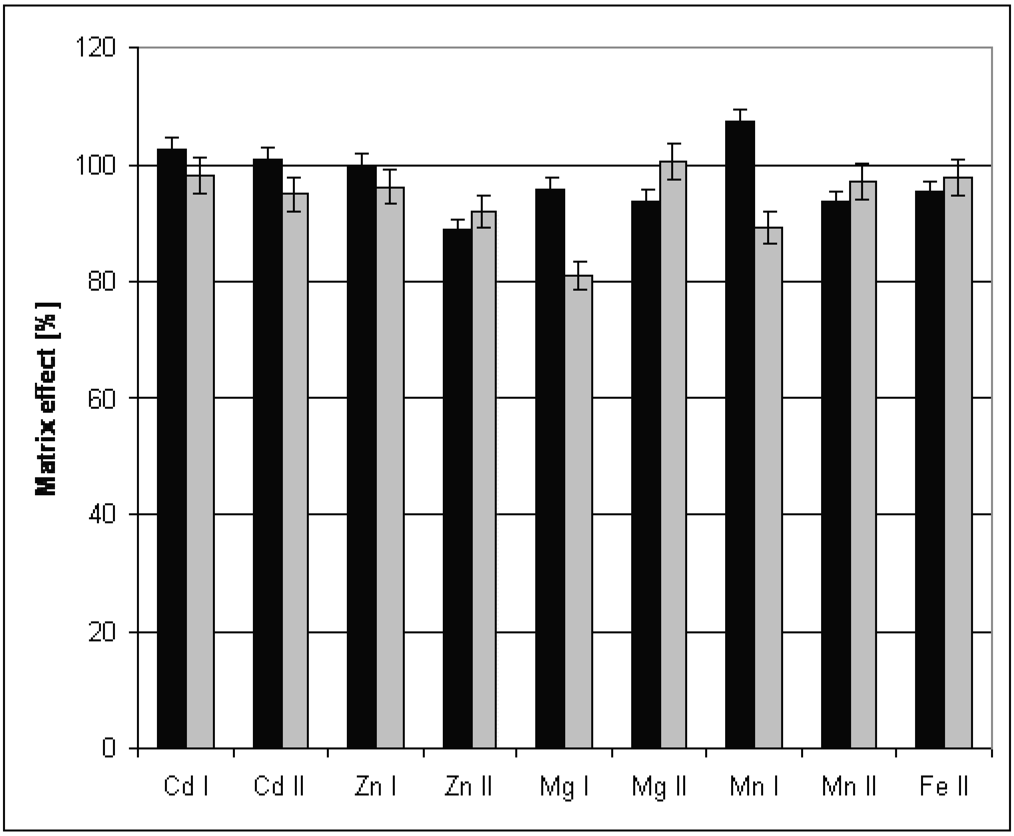


Fig. 5. The matrix effect from nitric acid on emission intensity of some metals by the Integra XL ICP-OES system with solution nebulization using NAR-1 and CCN

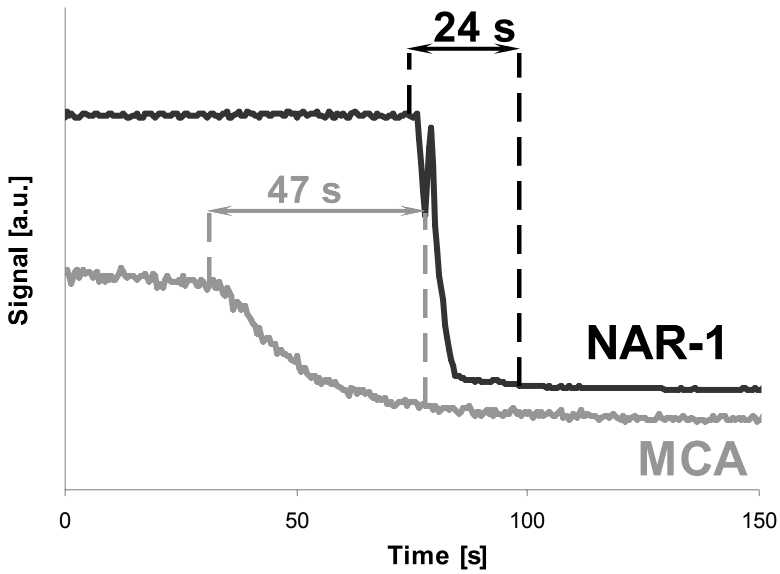


Fig. 6. The comparison of wash-out times for Zn for NAR-1 and MCA nebulizers at 0.15 ml min^{-1} of sample flow rate and 400 ml min^{-1} of nebulizer gas flow rate by MIP-OES