



**RESEARCH
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Electrochemistry
Group

EFFECTS OF ANODIZATION PARAMETERS ON PHYSICOCHEMICAL PROPERTIES OF THE OXIDE COATINGS ON MAGNESIUM

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Application

- (a) cardiovascular stents
- (b) screw
- (c) microclip for laryngeal microsurgery (pure magnesium)
- (a) biodegradable orthopedic implants
- (b) wound-closing devices

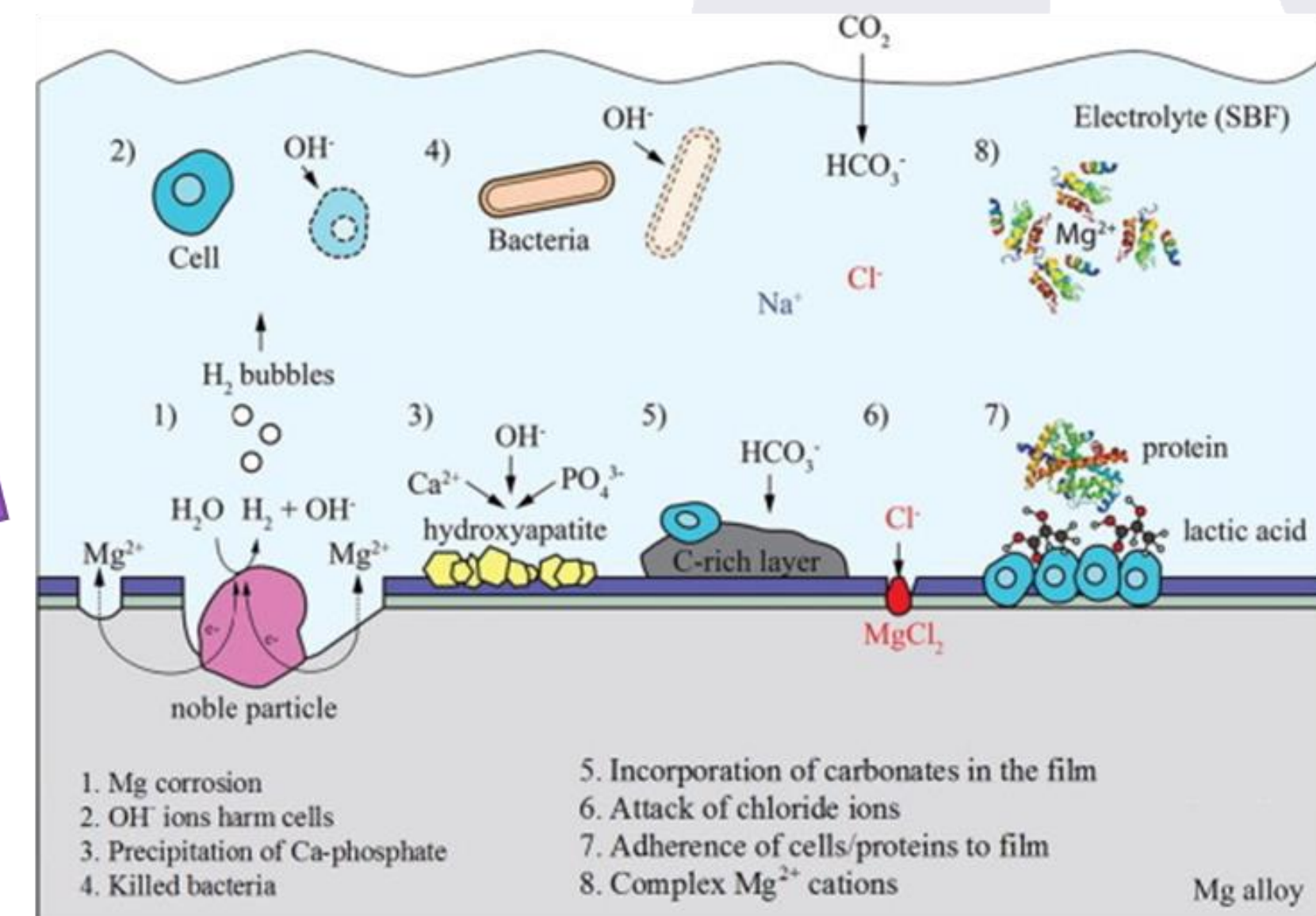
Advantages

- Proper Young's modulus
- Natural degradability
- Good biocompatibility
- Good osteopromotive property

Fast and uncontrolled corrosion

Corrosion prevention

Alloying elements, pretreatment, coatings



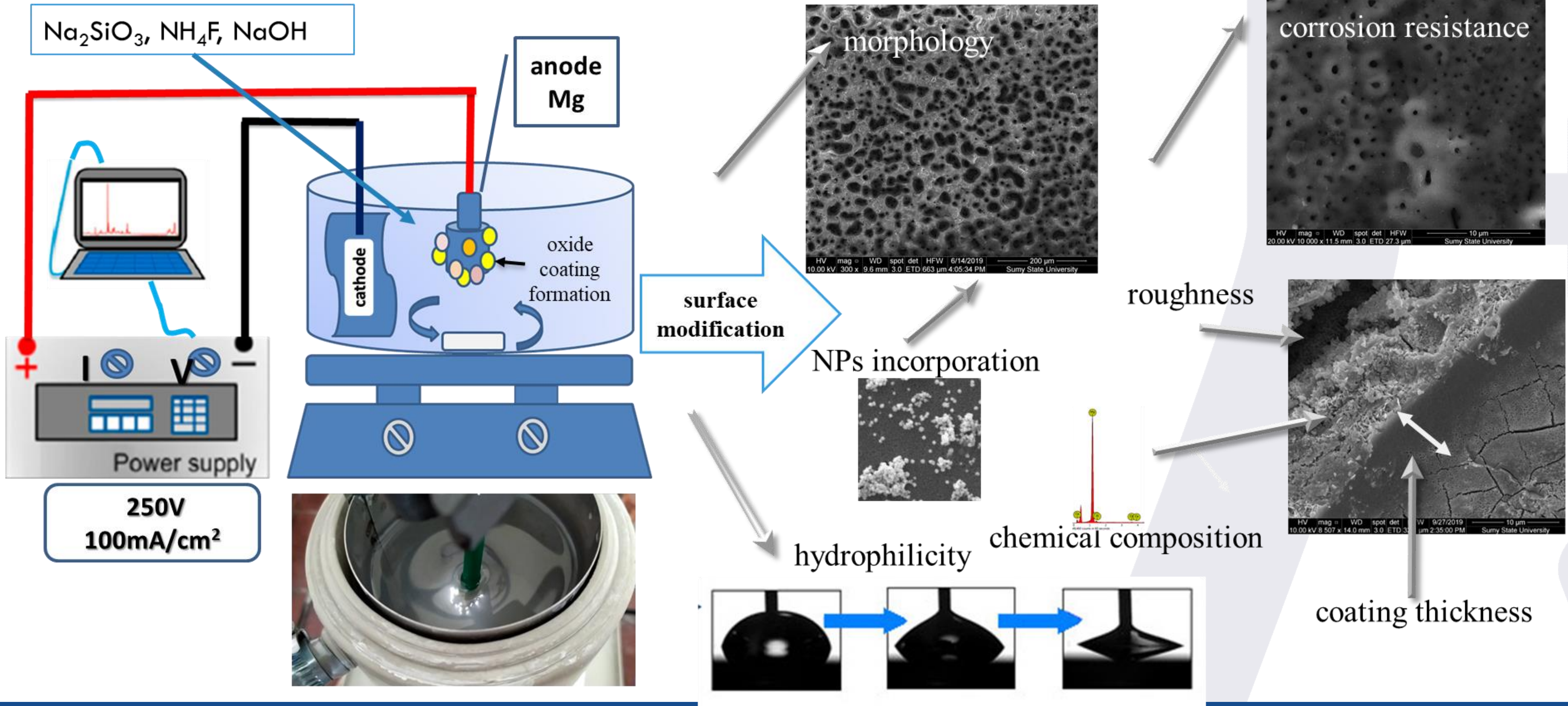
<https://doi.org/10.1016/j.matdes.2019.108259>

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Plasma Electrolytic Oxidation (PEO)

The **aim** of this study to select the PEO process parameters to achieve the best magnesium surfaces' physicochemical properties for further biomedical applications.

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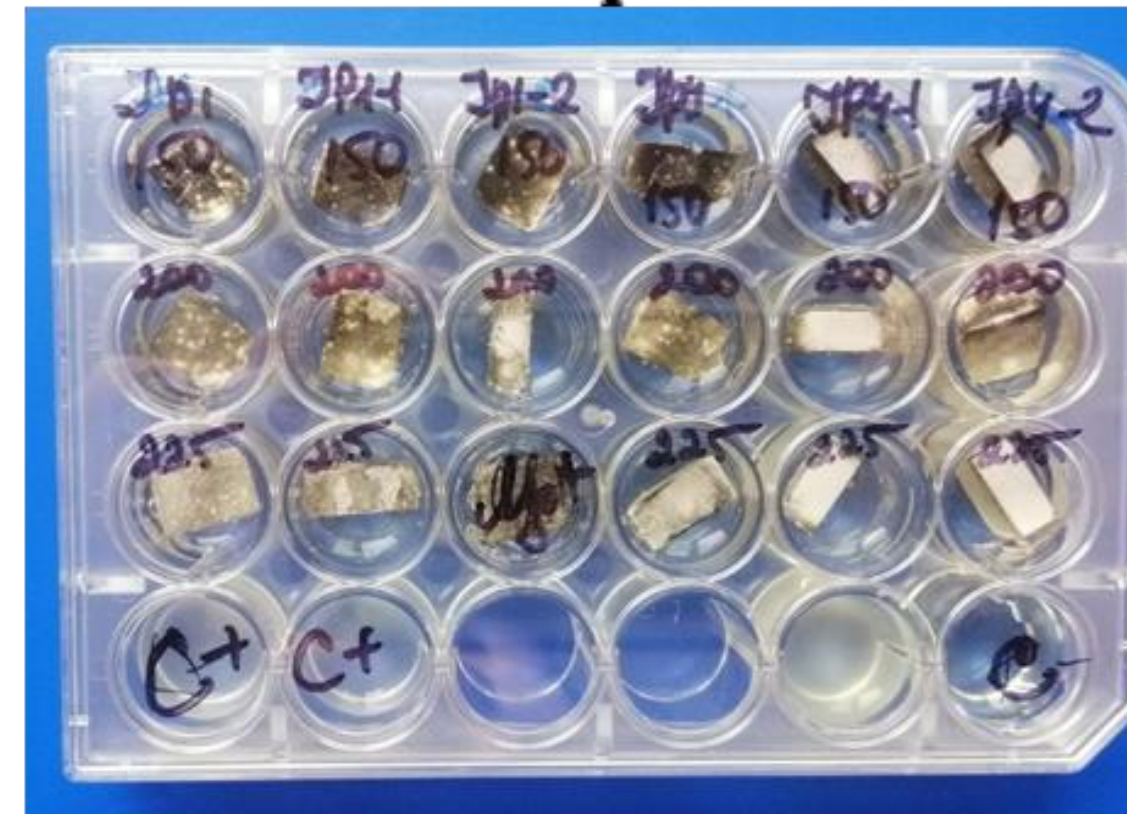




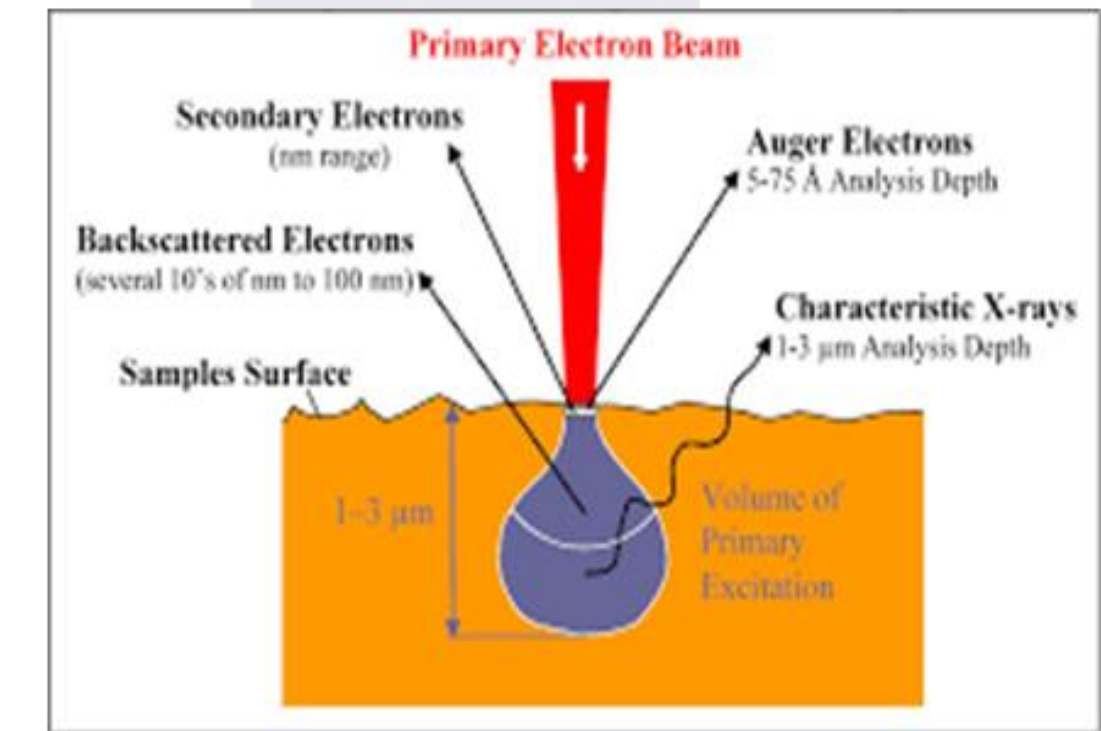
Sample code	Composition of the bath electrolyte
JP1	10 g/L Na ₂ SiO ₃ ·5H ₂ O, 5 g/L NH ₄ F, 10 g/L NaOH;
JP1-1	20 g/L Na ₂ SiO ₃ ·5H ₂ O, 5 g/L NH ₄ F, 10 g/L NaOH;
JP1-2	30 g/L Na ₂ SiO ₃ ·5H ₂ O, 5 g/L NH ₄ F, 10 g/L NaOH

- **Plasma Electrolytic Oxidation (PEO)**
- **Scanning Electron Microscopy (SEM)**
- **X-ray spectroscopy (EDX)**
- **Roughness Measurement**
- **Bacteriological analysis**
- **Cell culture investigation**

Samples



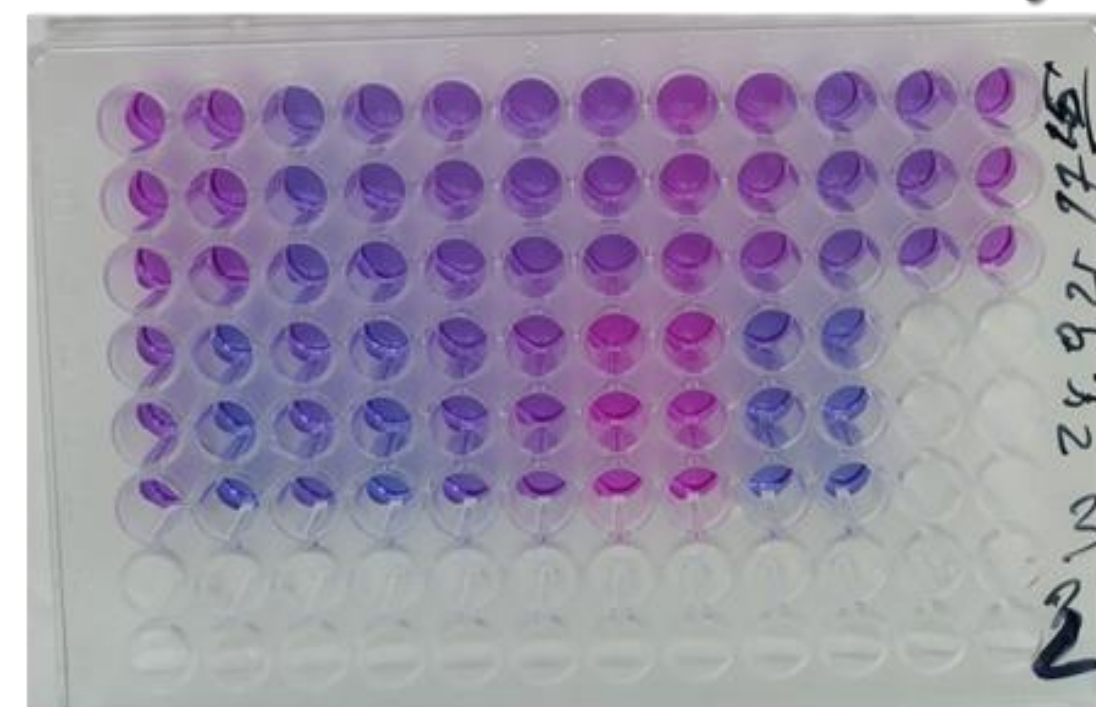
EDX



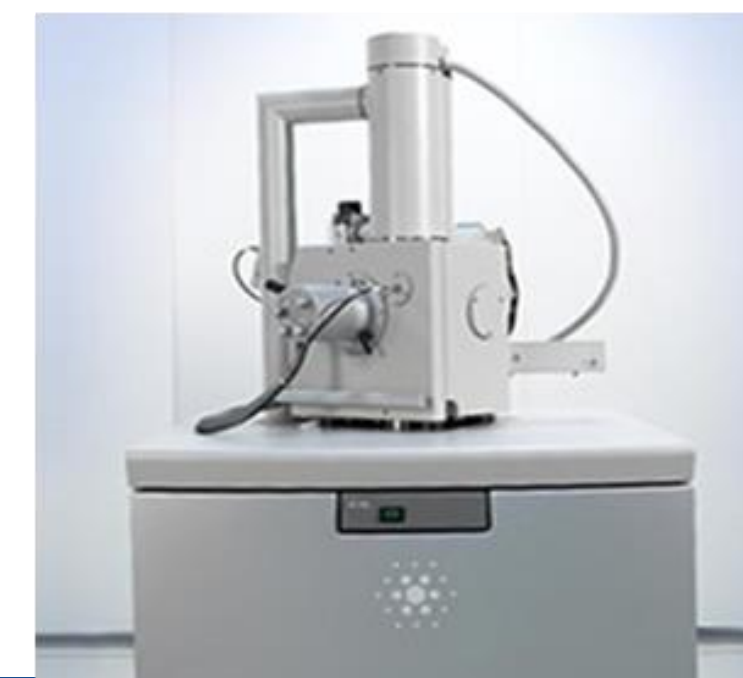
Roughness measurement

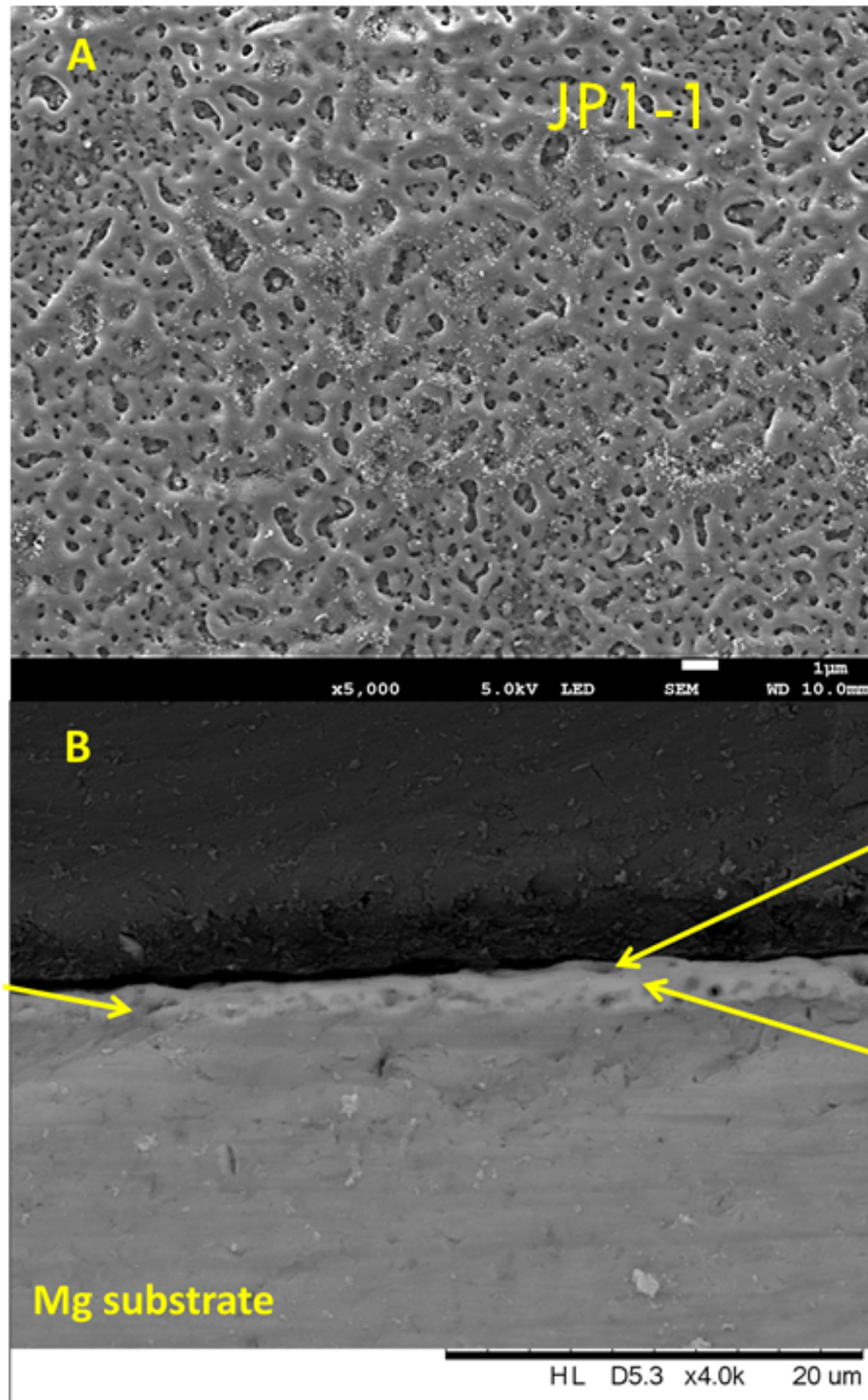


Resazurin reduction assay



SEM





A – PEO coating surface, B – cross section

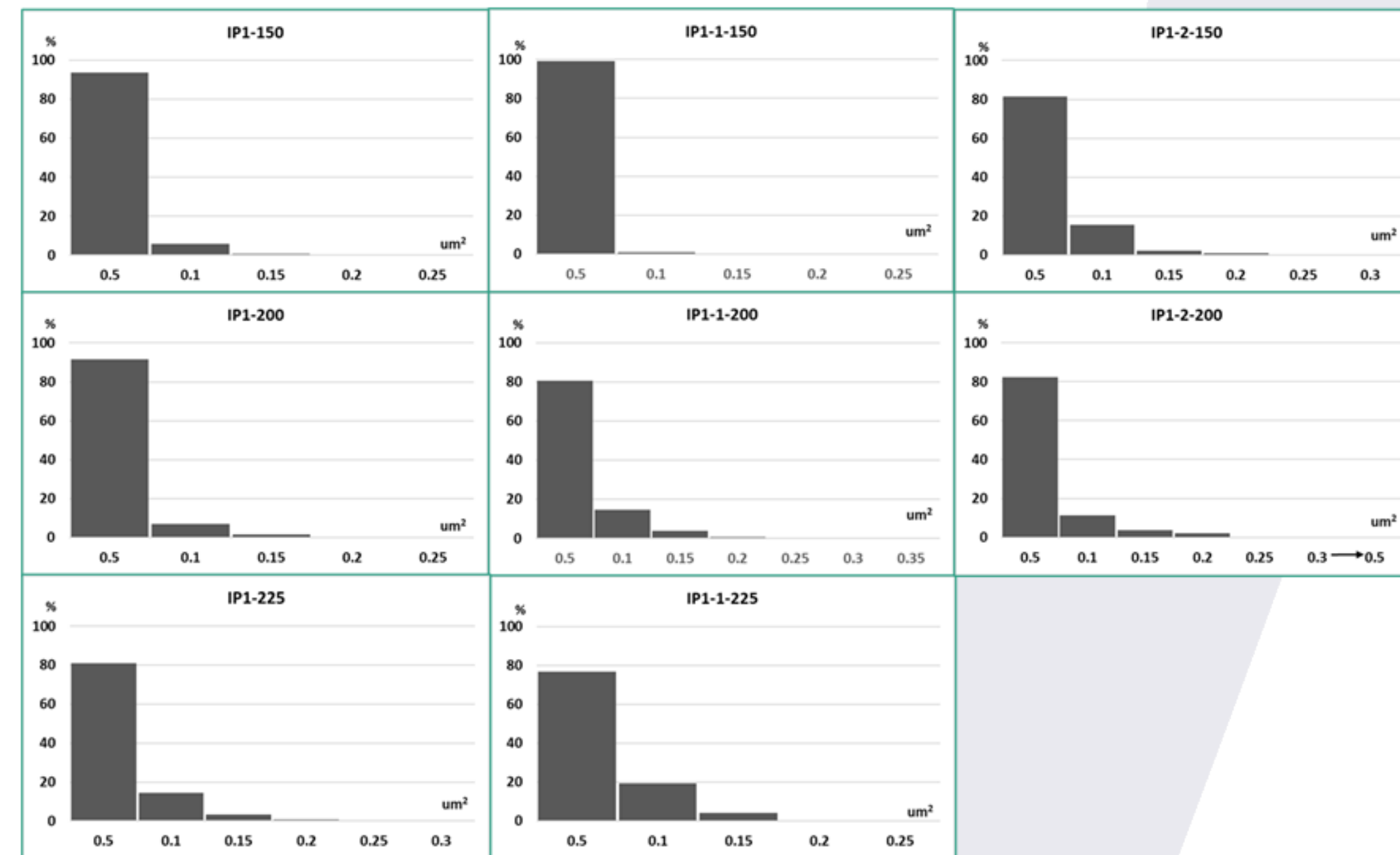
SEM images of samples anodized at 200V in silicate solution

Pore size of the obtained coatings, μm^2

Sample code	IP1-150	IP1-200	IP1-225	IP1-1-150	IP1-1-200	IP1-1-225	IP1-2-150	IP1-2-200
Mean	0.021	0.022	0.033	0.008	0.034	0.034	0.031	0.032
SD	0.018	0.021	0.032	0.010	0.041	0.026	0.030	0.043

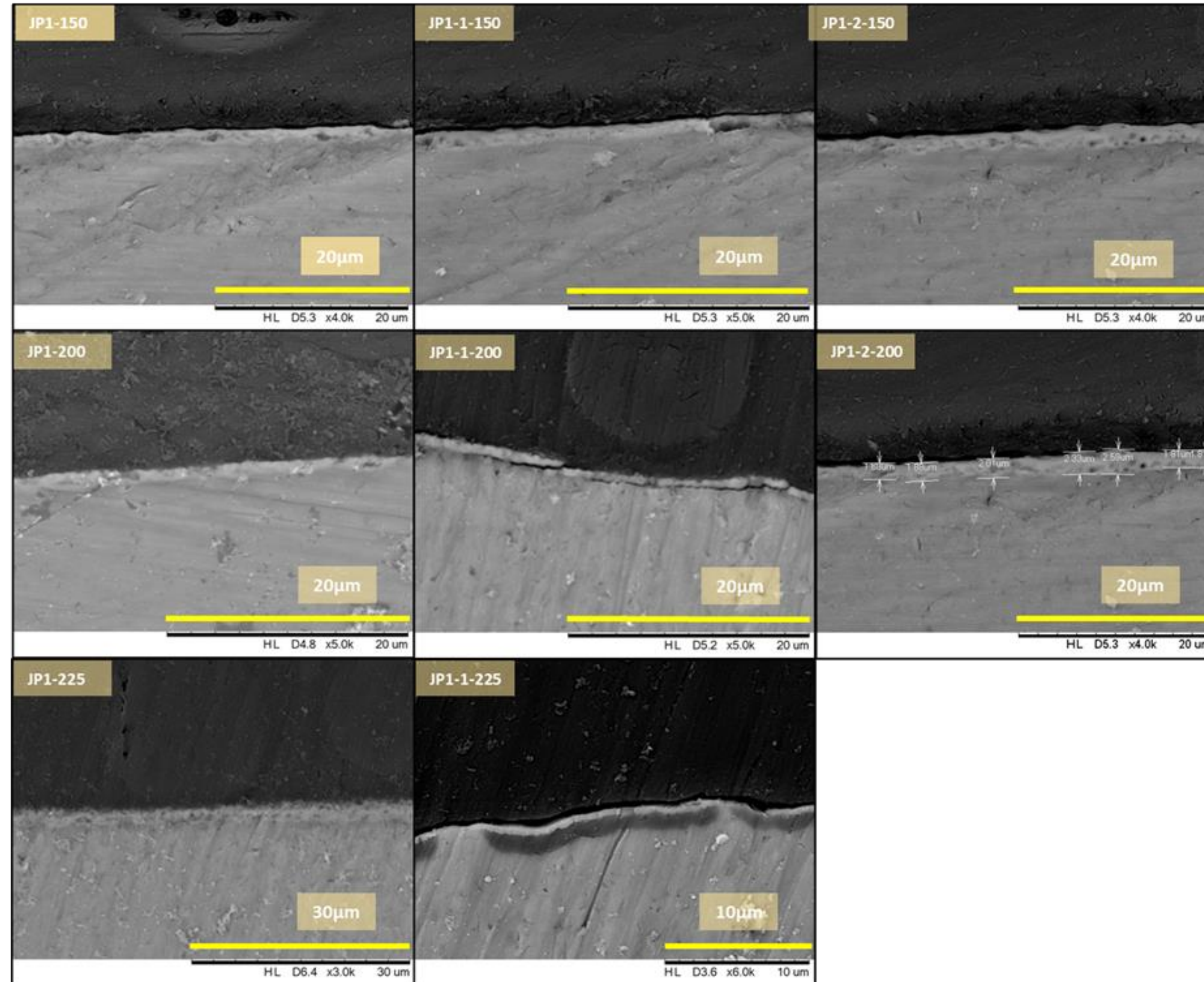


Pore size distribution of the obtained coatings, %



Results: morphology and chemical composition

Scanograms cross-section of the obtained coatings



Thickness of the obtained coatings, μm

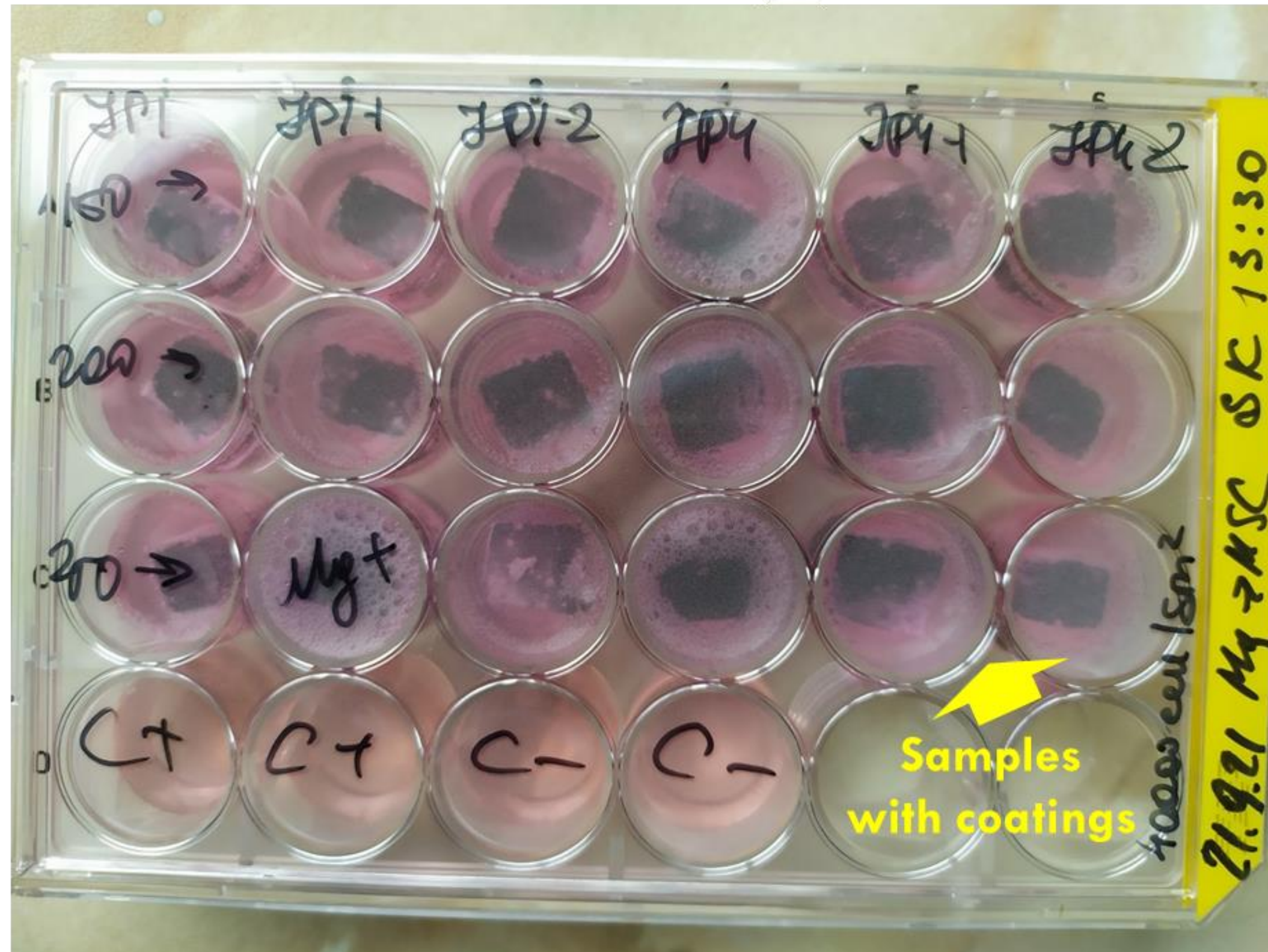
Sample code	IP1-150	IP1-200	IP1-225	IP1-1-150	IP1-1-200	IP1-1-225	IP1-2-150	IP1-2-200
Mean	0.021	0.022	0.033	0.008	0.034	0.034	0.031	0.032
SD	0.018	0.021	0.032	0.010	0.041	0.026	0.030	0.043

EDX spectra analyses of the obtained coatings

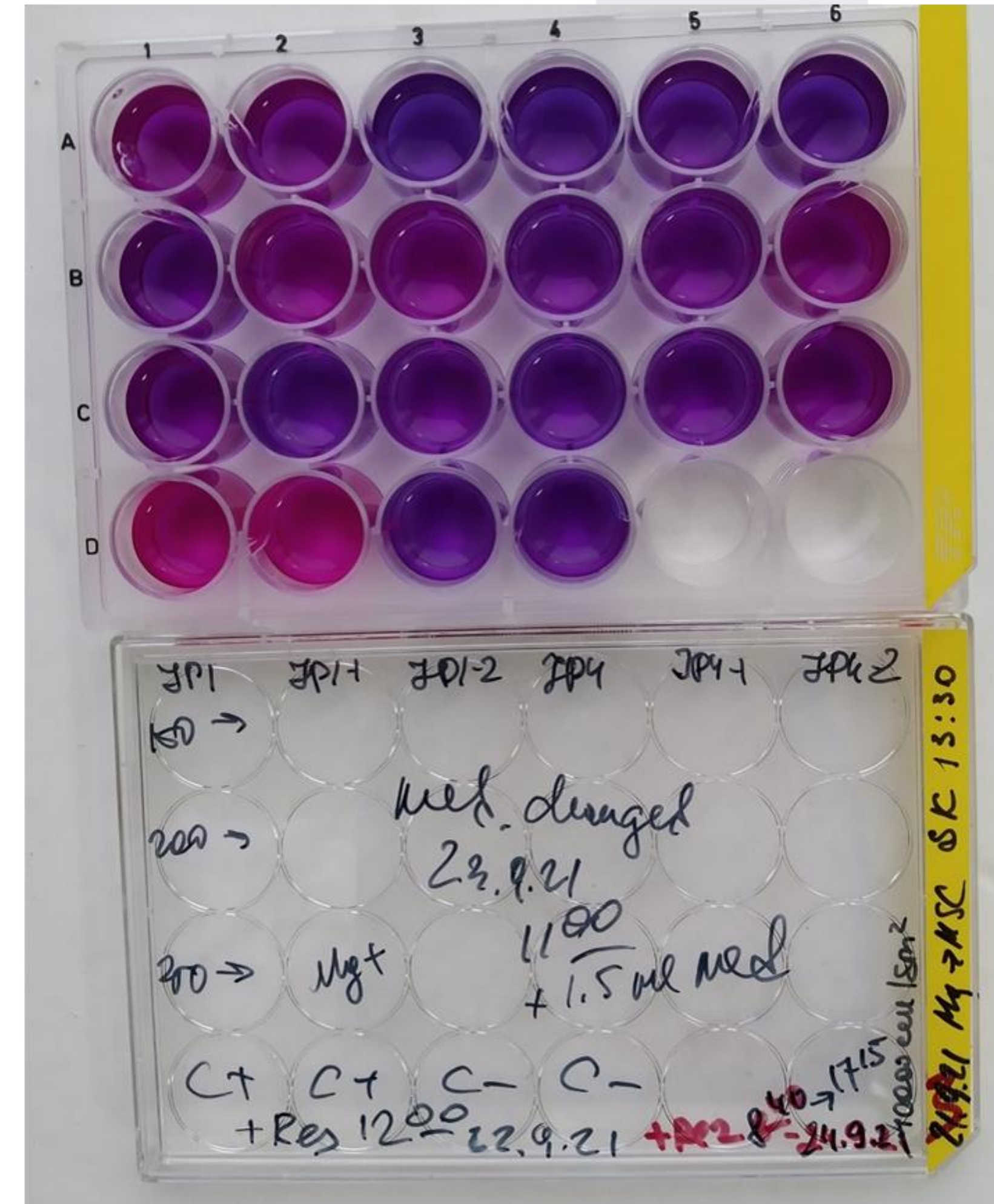
At %	IP1-150	IP1-200	IP1-225	IP1-1-150	IP1-1-200	IP1-1-225	IP1-2-150	IP1-2-200
O	21.43	32.54	39.88	16.73	23.57	44.08	23.27	34.47
F	3.44	6.50	8.01	2.89	4.58	9.38	1.96	3.14
Mg	69.86	55.93	44.40	78.36	67.86	32.04	71.04	52.39
Si	2.64	5.03	6.89	2.48	3.99	12.52	3.74	9.01
Na	2.62		0.81			1.97		1.00

Results: Cell culture investigation

Human umbilical cord mesenchymal stem cells (UCMSC)

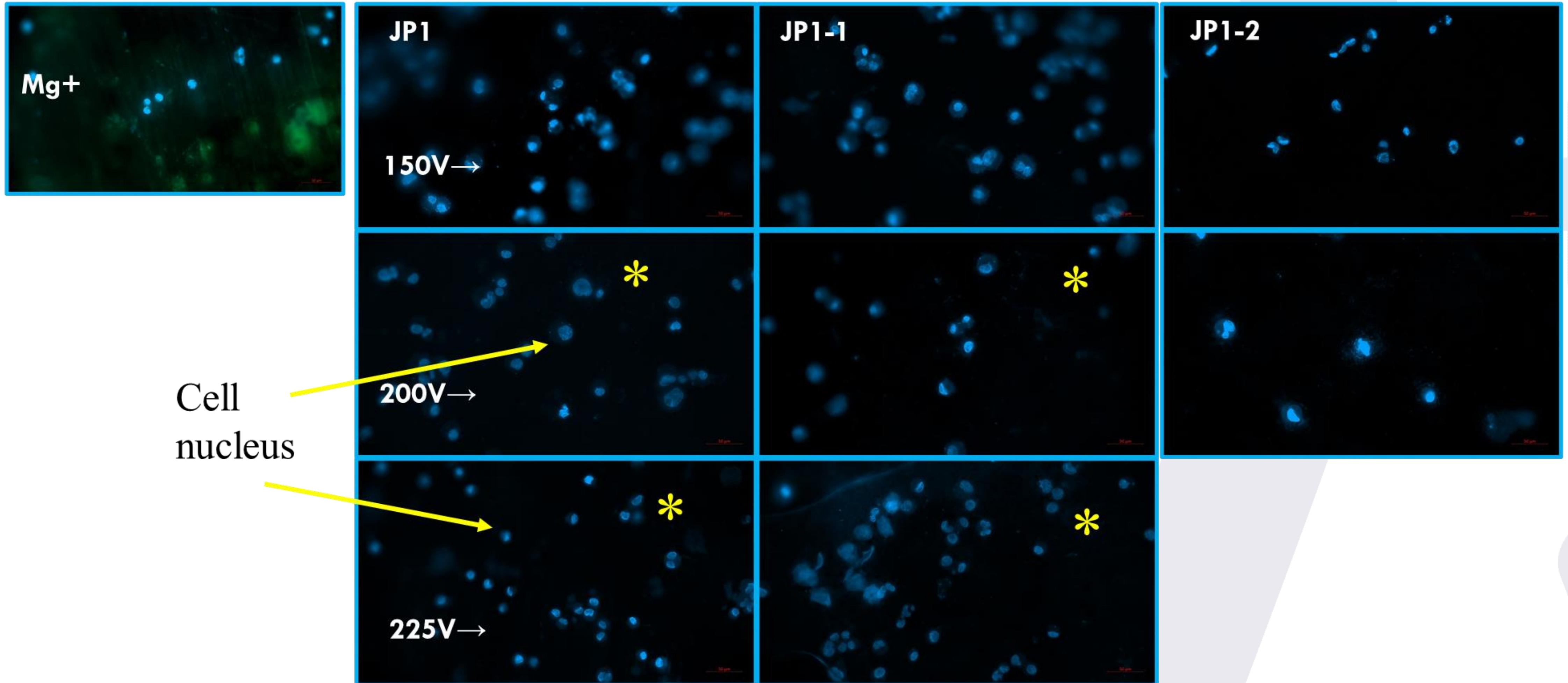


Resazurin reduction test – cells viability measurements



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Fluorescent DAPI staining



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Cell nucleus

JP1

JP1-1

JP1-2

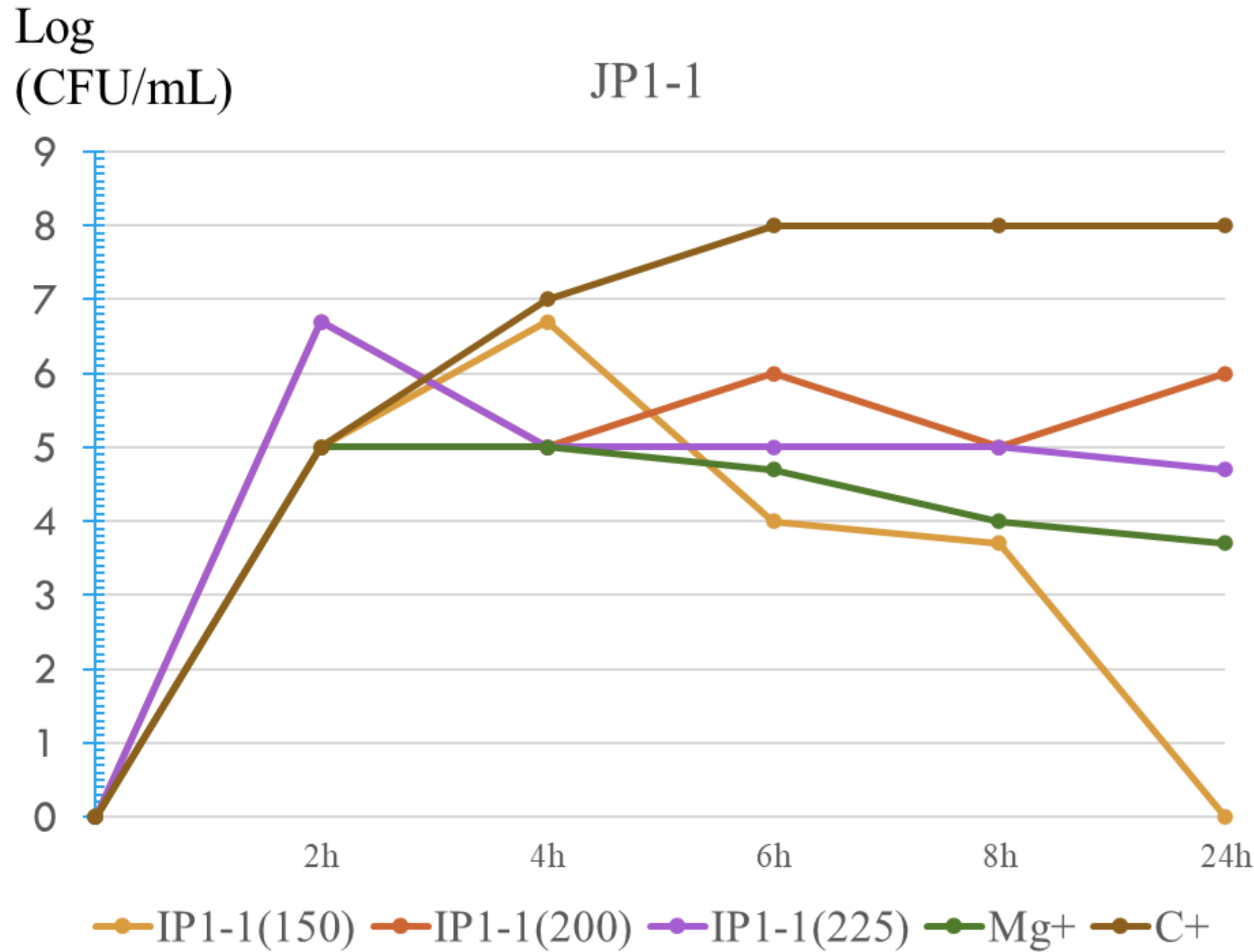
150V →

200V →

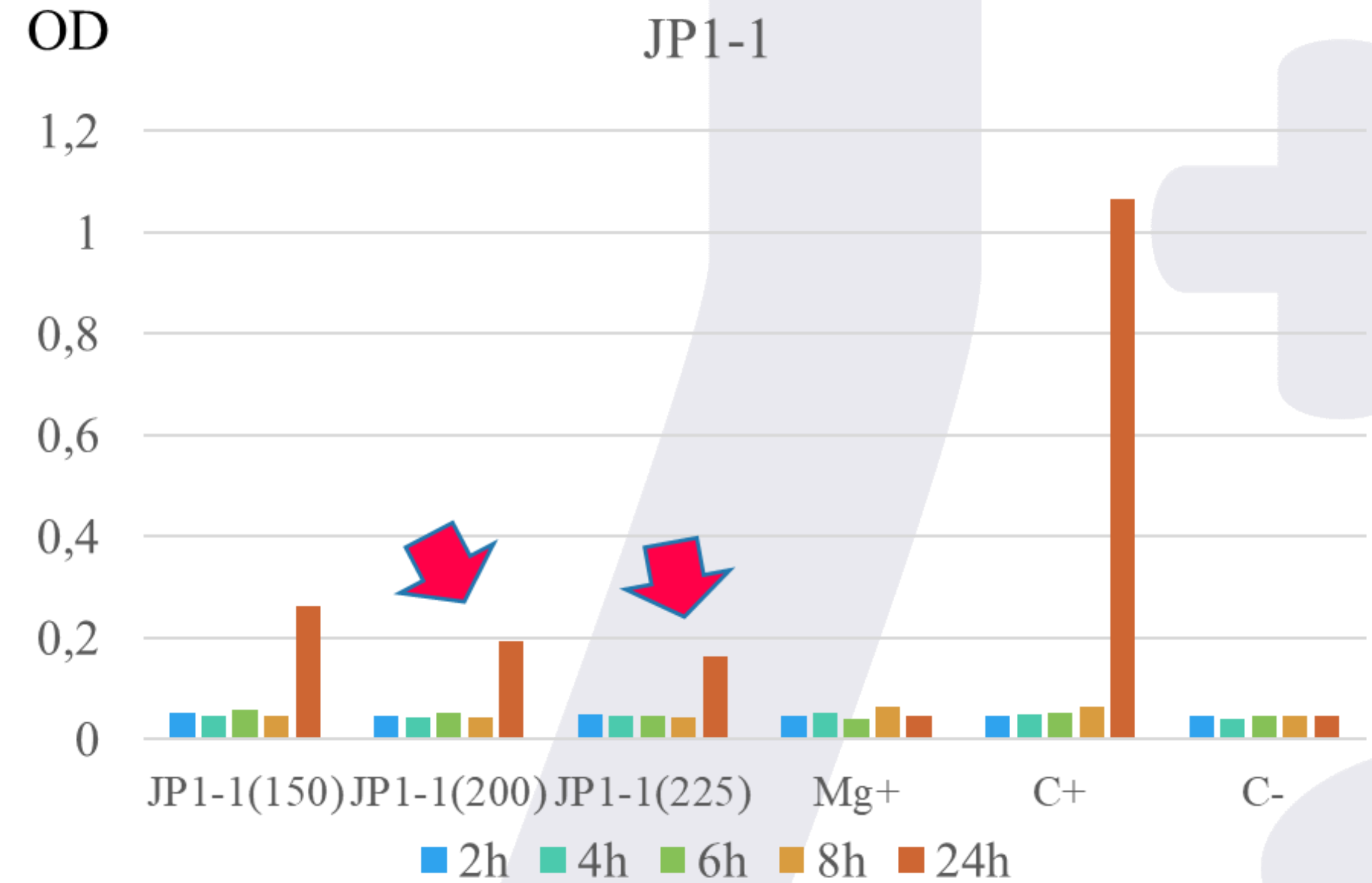
225V →



Inhibition test

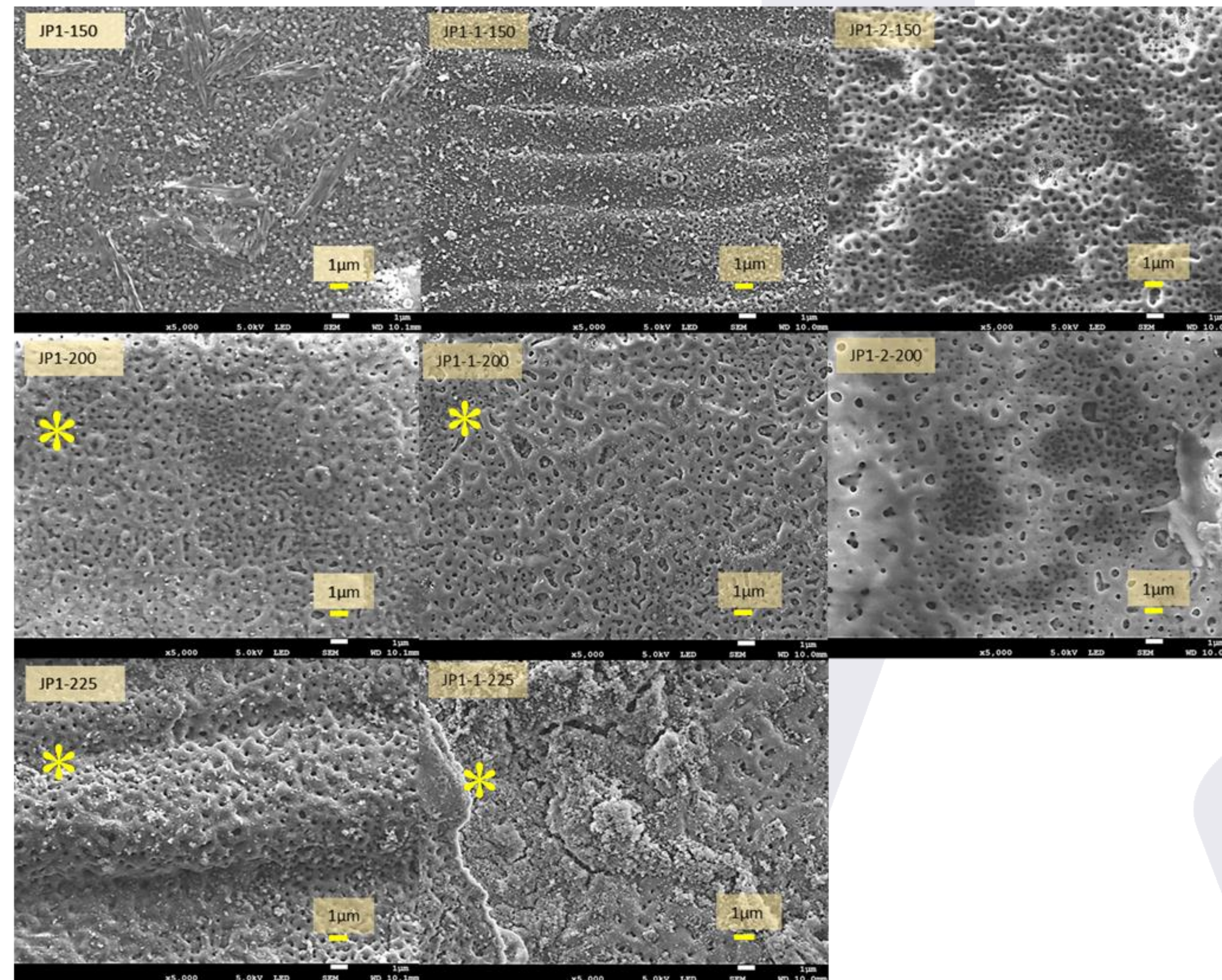


Optical density test



Conclusion

The pore size and its distribution, the thickness, and the chemical composition of the obtained films are more appropriate at the low concentration of the Na_2SiO_3 and 200 V and 225 for further in-vitro investigation.



Thank you!

