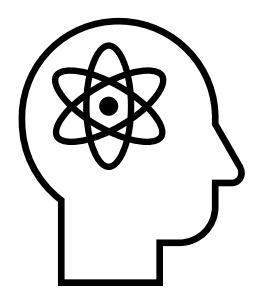


A thin-layer hafnium oxide as auxiliary layer obtained by atomic layer deposition onto macroporous silicon for SERS



K. Girel^{1,2}, K. Litvinova³, A. Burko^{1,2}, S. Dubkov², A. Savitsky², D. Novikov², A. Tarasov², H. Bandarenka^{1,2}

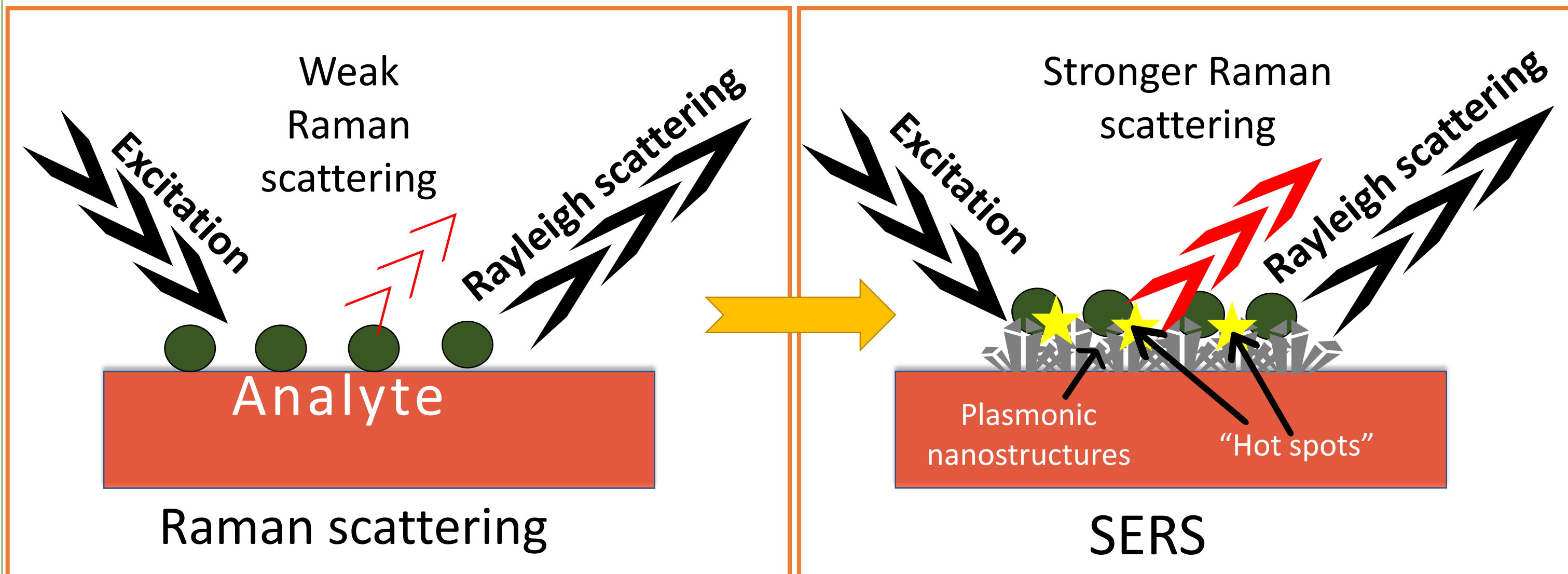
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What is SERS?

Surface-enhanced Raman scattering



Opportunities of SERS

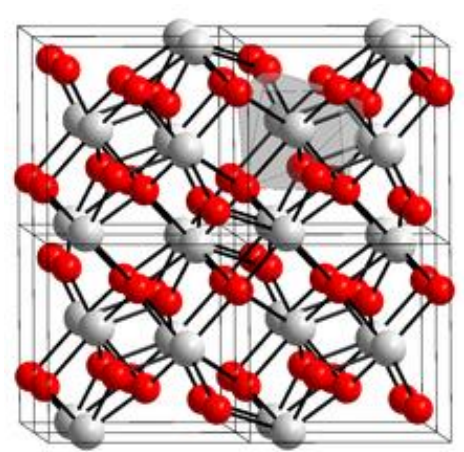
- Label-free detection of biomarkers
- Study of chemical reactions
- Explosives' and toxins' sensing
- Early clinical diagnostics
- Environmental/food/industrial surveillance

Problems of SERS-substrates

- Chemical instability
- Disposability
- Cytotoxicity
- Photothermal effect

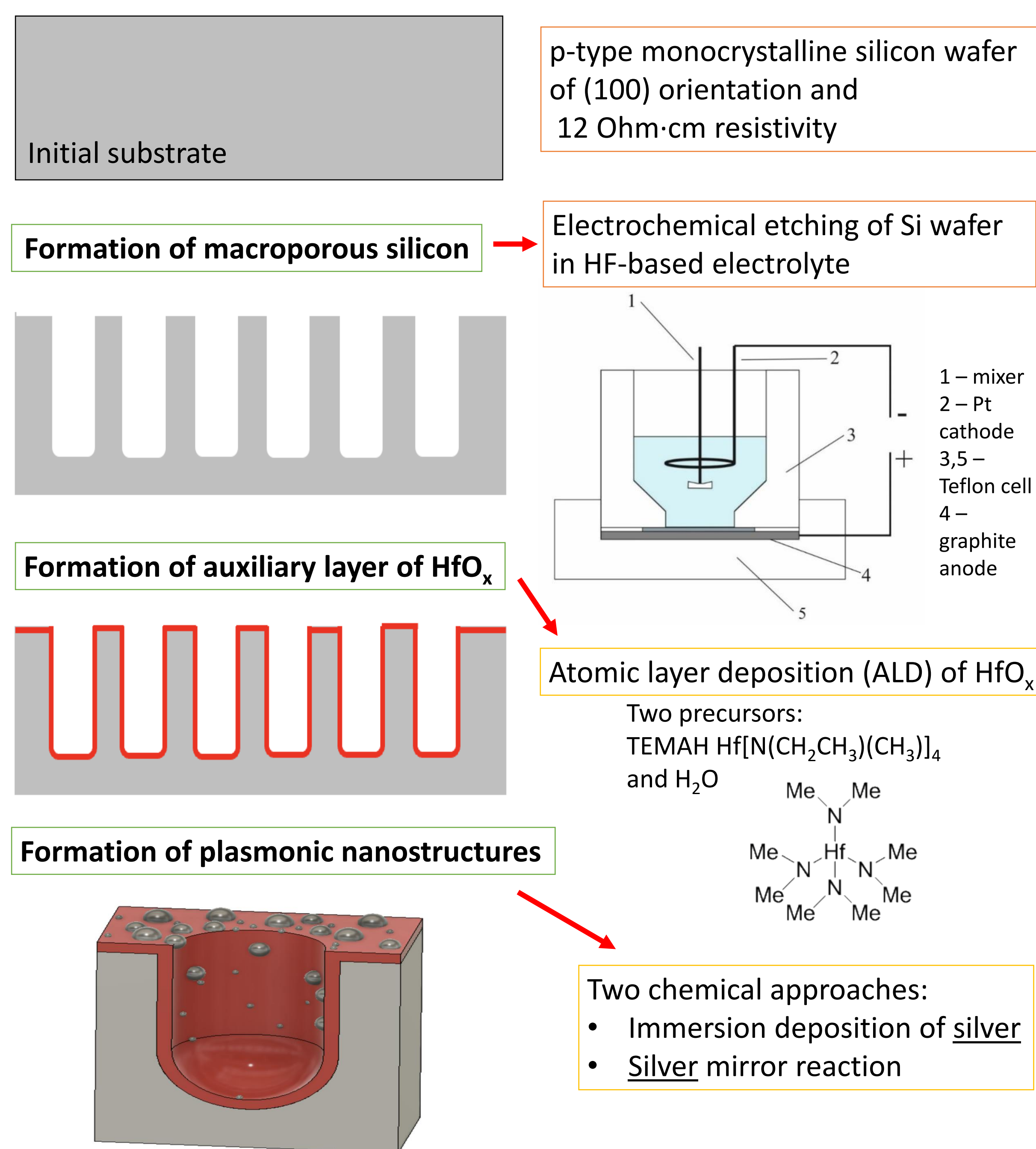
Solution – plasmonic nanostructures on biocompatible template modified with auxiliary oxide layer → **Porous Si (PS) + HfO_x**

Hafnium oxide



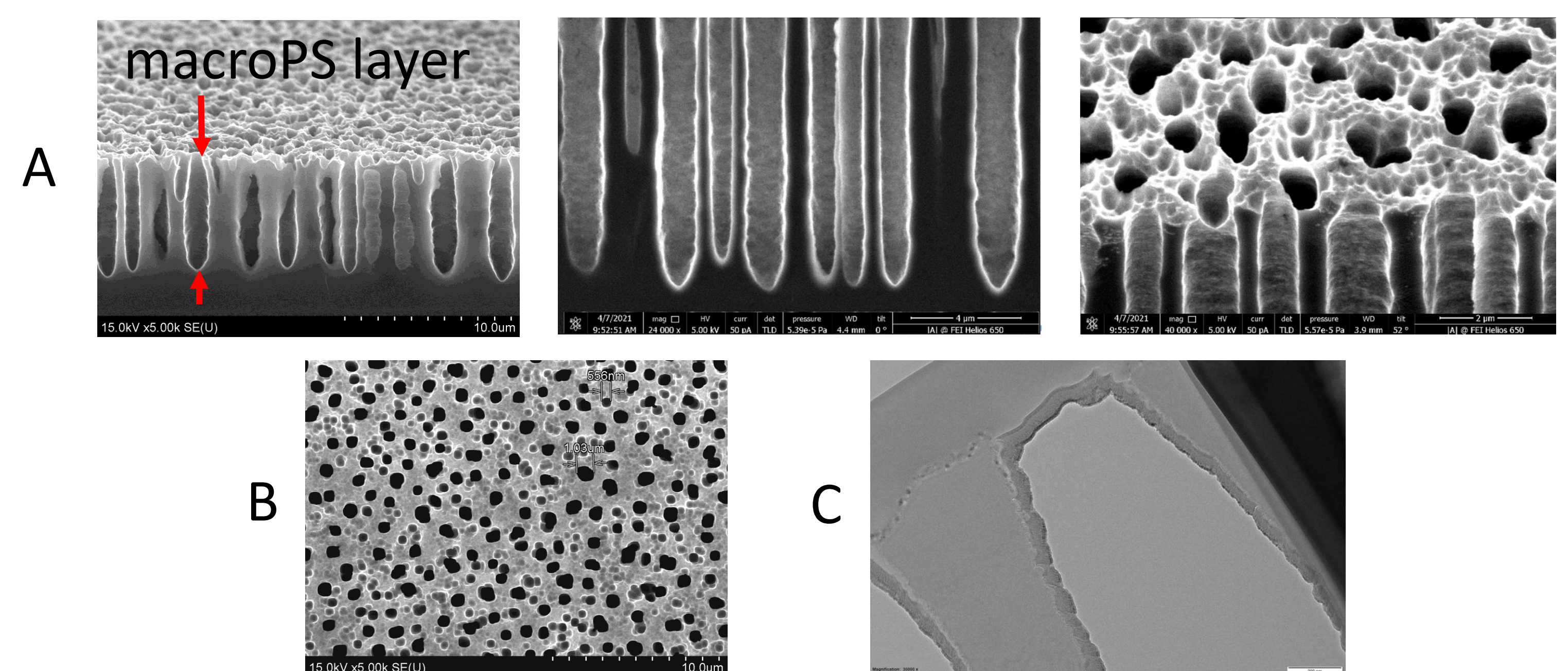
- optical coatings
- a gate insulator in field-effect transistors
- a high-κ dielectric in DRAM capacitors

Formation of SERS-substrates

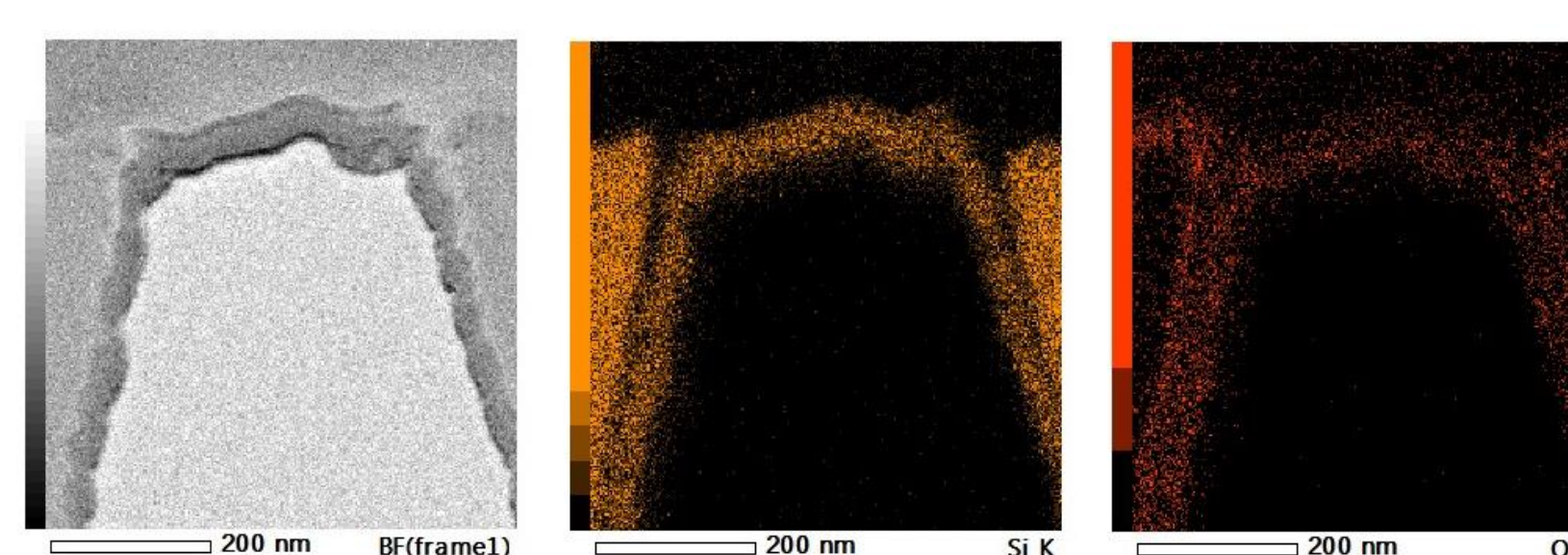


Morphology

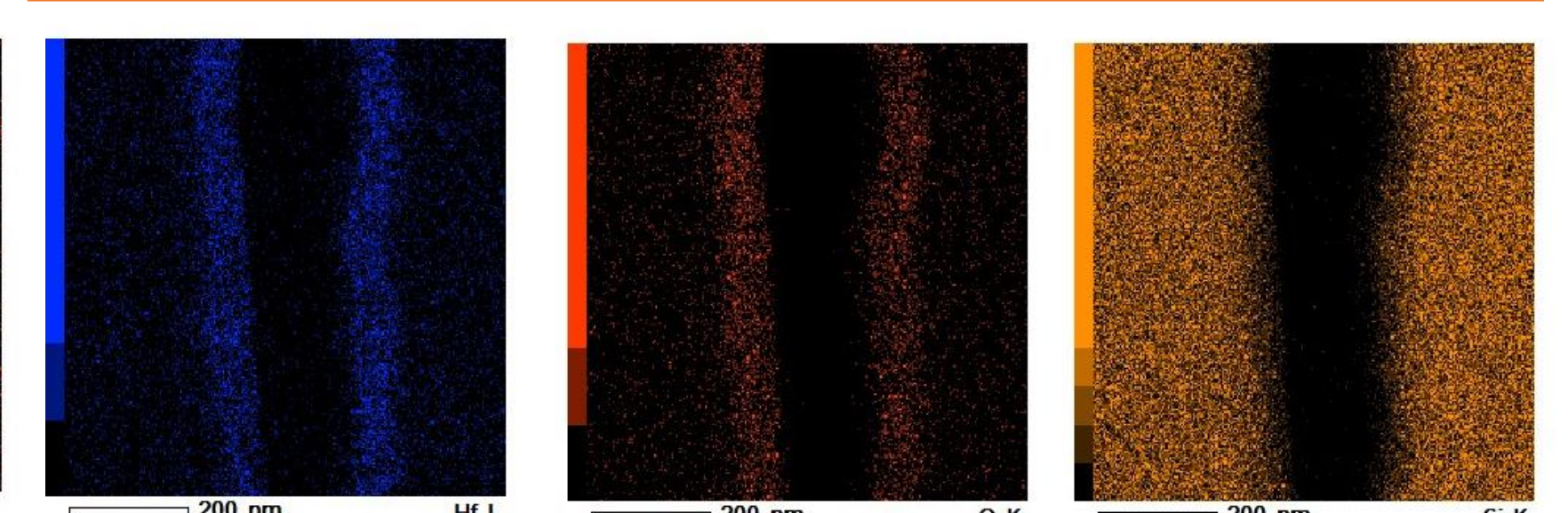
SEM image of macroporous silicon: cross-section (A), top view (B), TEM image (C)



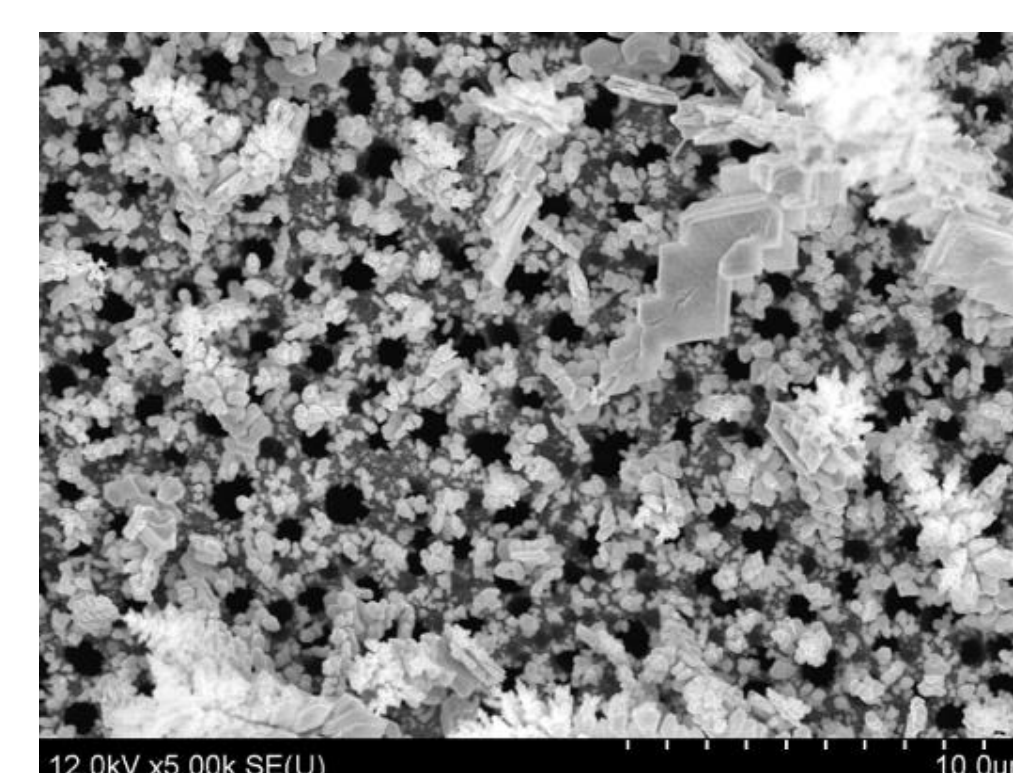
TEM/EDX analysis of macroPS



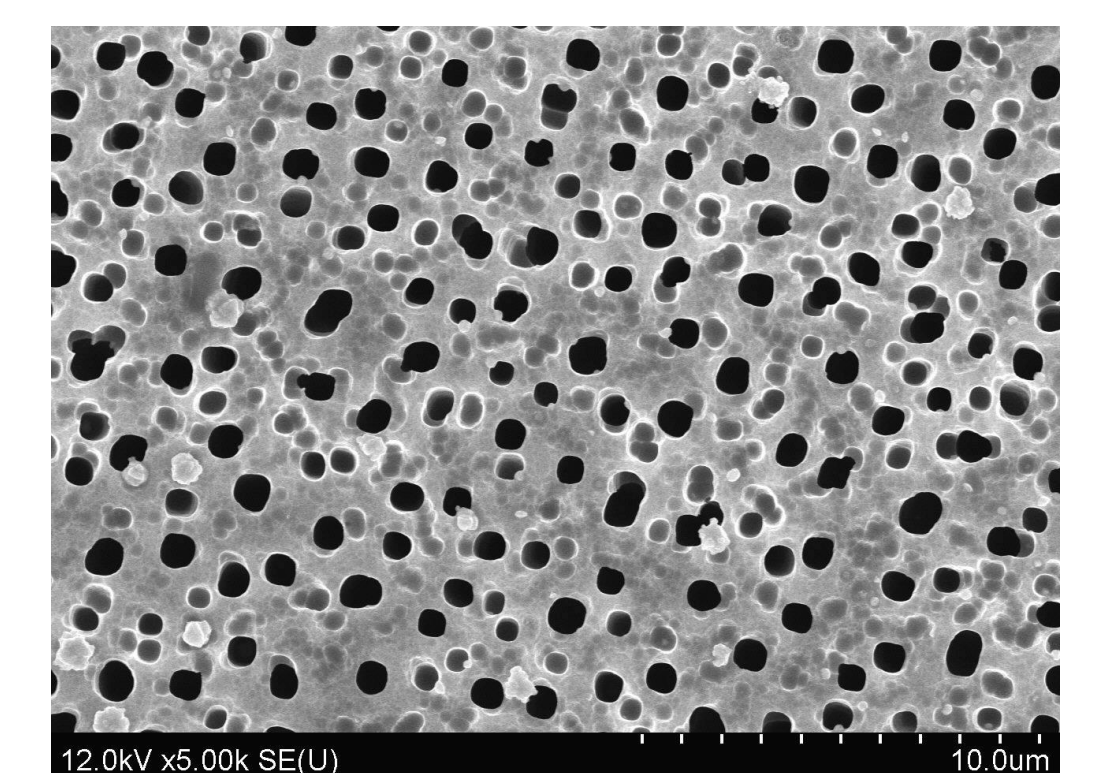
TEM/EDX analysis of macroPS after ALD of HfO_x



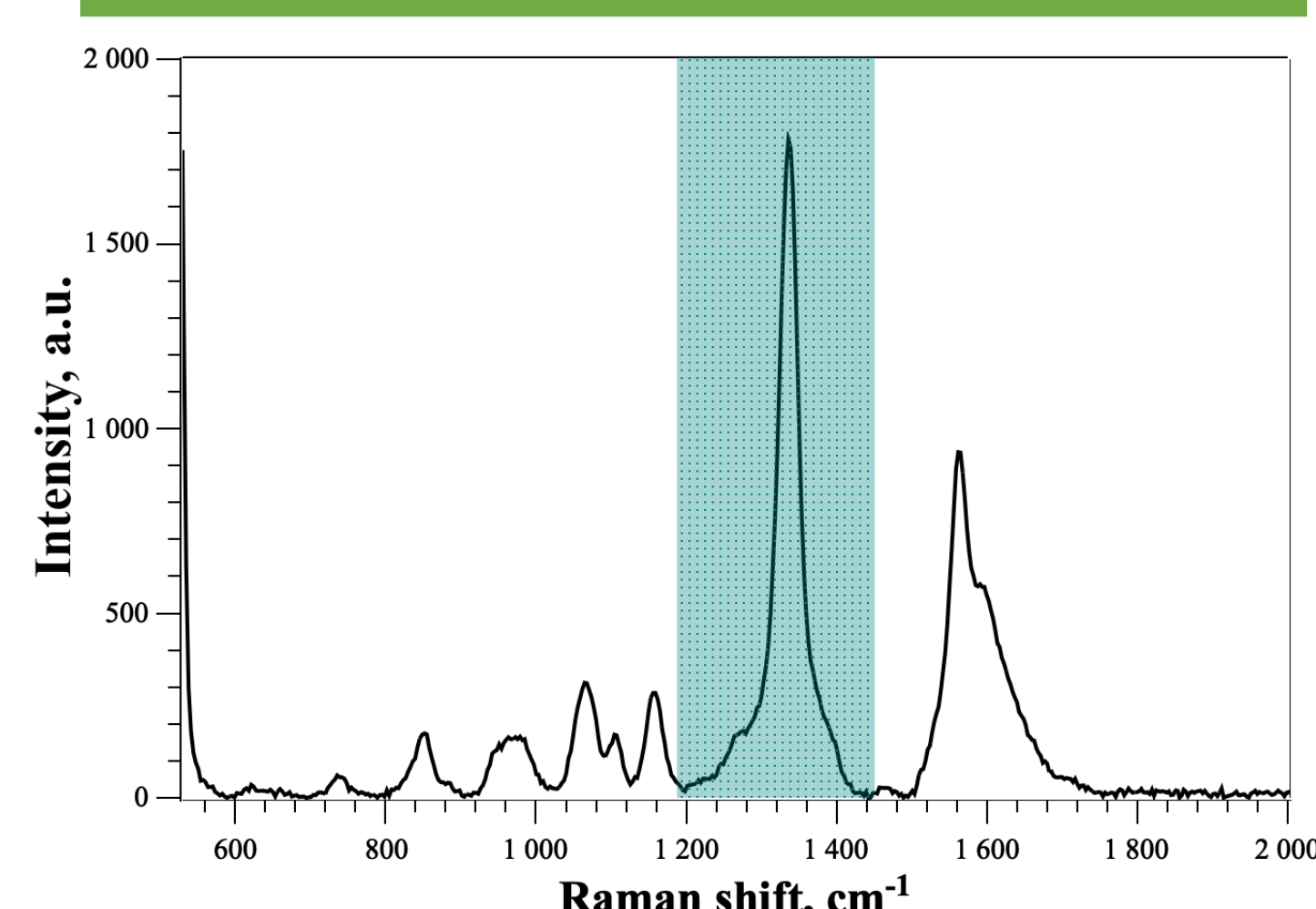
MacroPS/HfO_x after silver mirror reaction



MacroPS/HfO_x after immersion deposition of silver



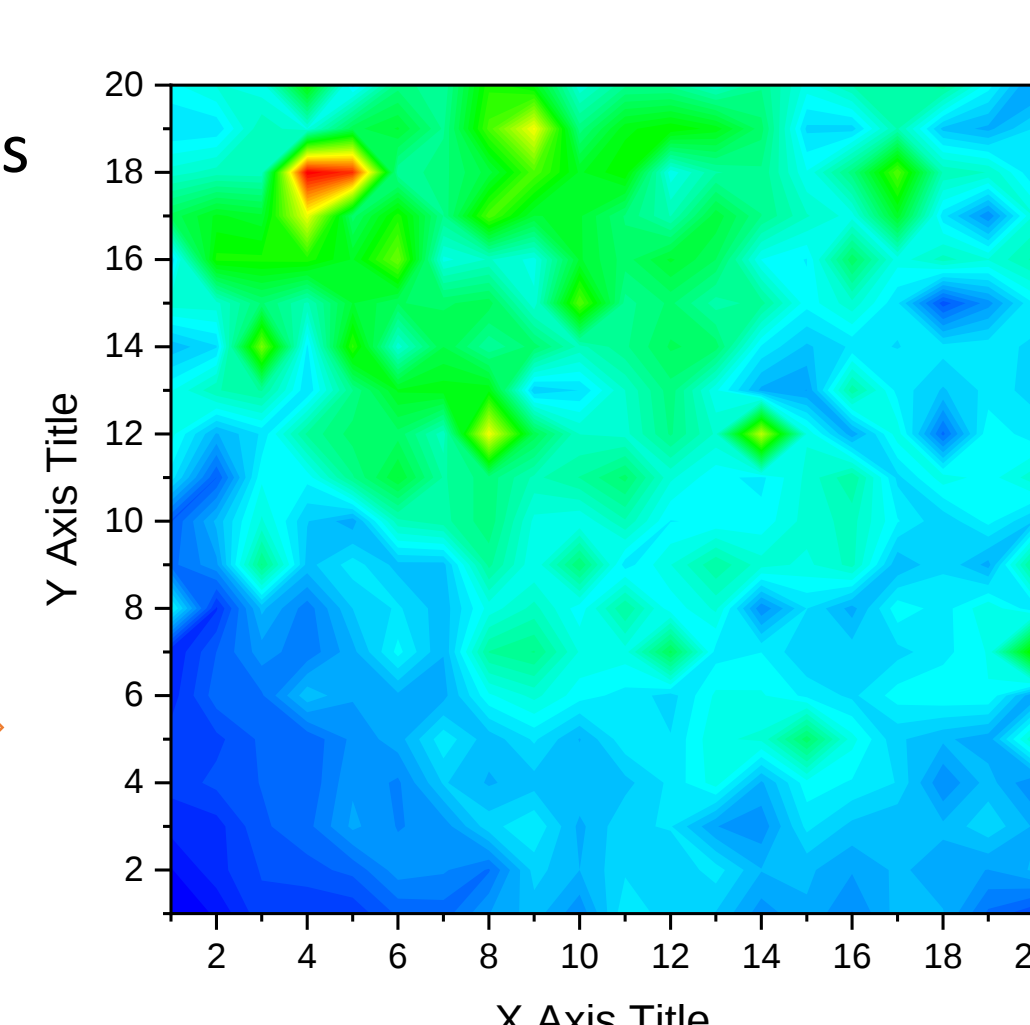
SERS



Laser – 473 nm
Objective – 40x
Excitation time – 1 s

Mapping
340x340 μm.
400 spectra

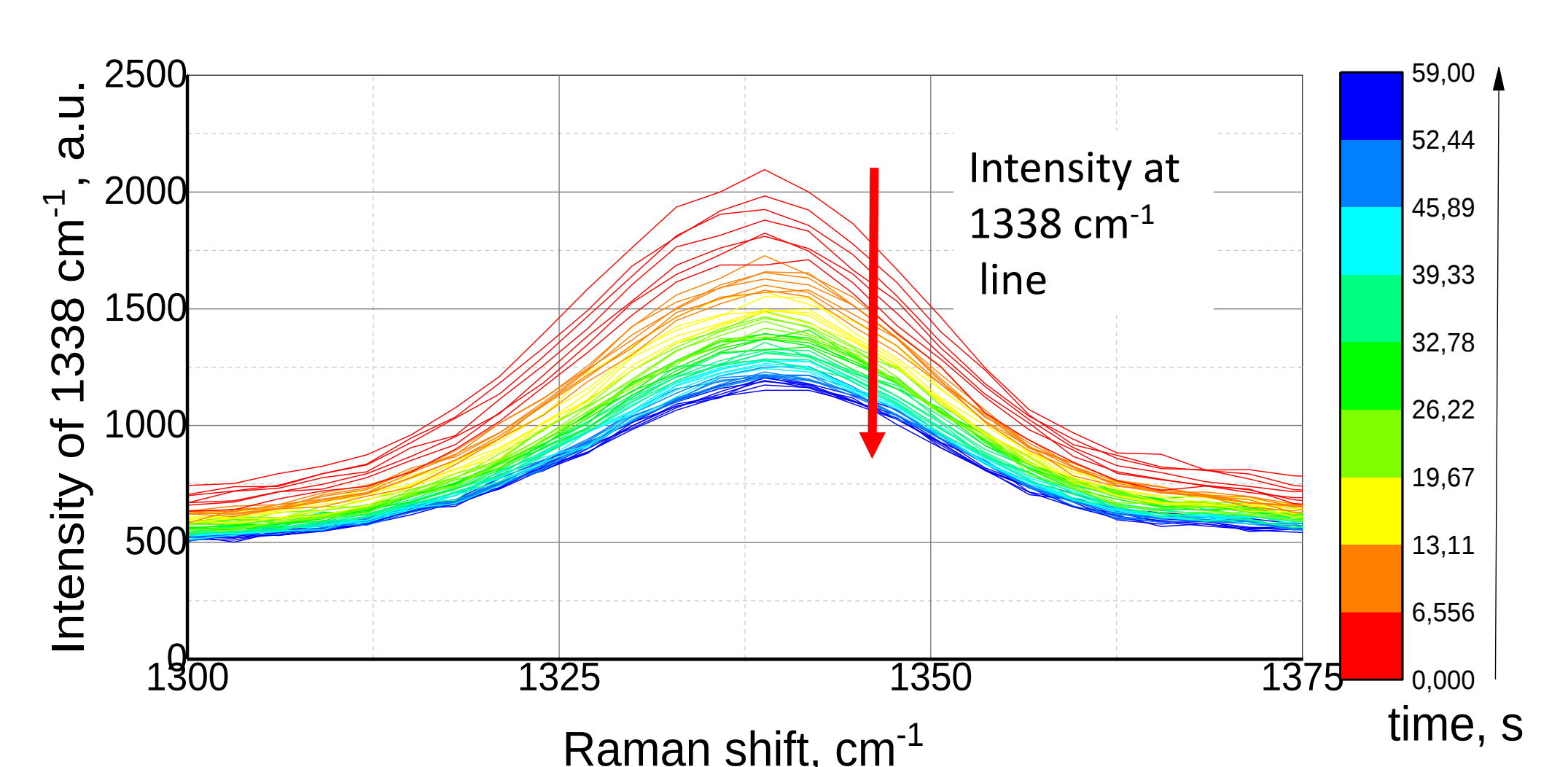
Distribution of intensity at 1338 cm⁻¹ line



Analyte - DTNB (Ellman's Reagent (5,5-dithio-bis-(2-nitrobenzoic acid)) – 10⁻⁵M

Kinetics

Time: 60 s



The research was supported by BRFFR and RFBR (projects №T21PM-136, №20-58-04016).