Point Of Use Colorimetric Probes Based On Electrospun Fibres

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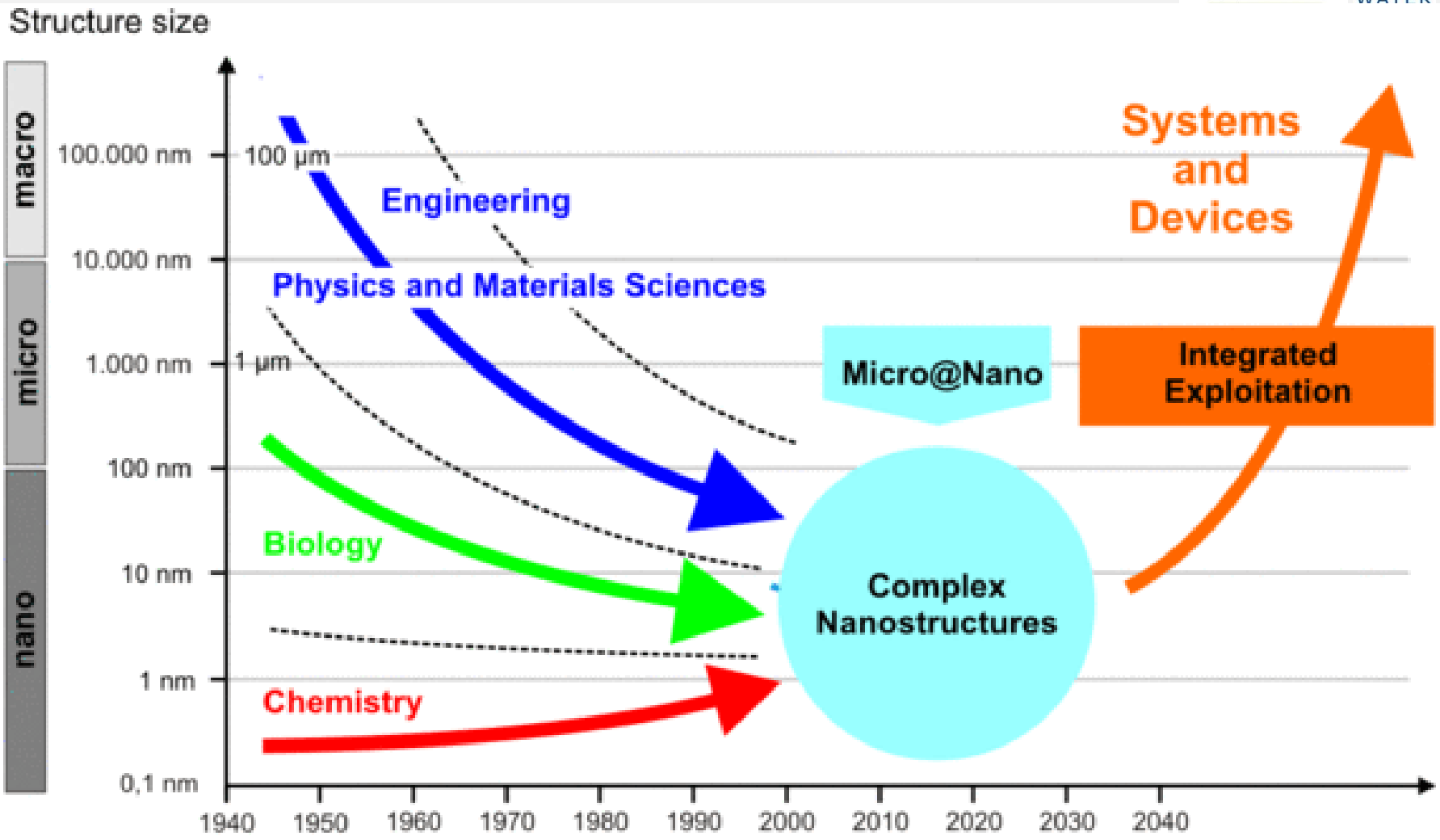
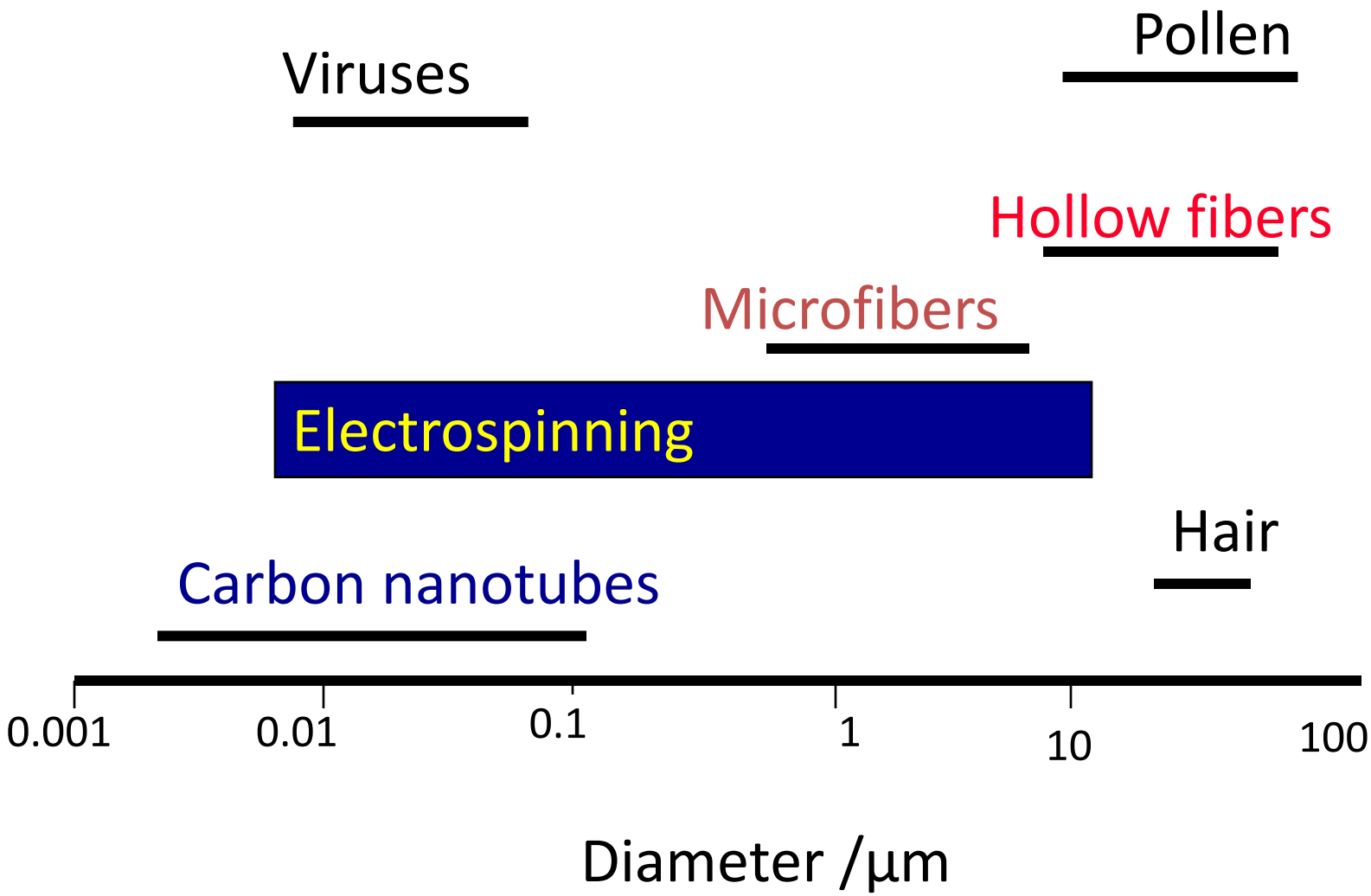


http://www.nano.boku.ac.at


Pollen
Viruses
Hollow fibers
Microfibers
Electrospinning
Hair
Carbon nanotubes
0.001
0.01
0.1
1
10
100
Diameter /µm

Africa's Challenge

Water from source

Transport and storage

Accredited laboratory

Screening, Analysis, Data capture

48 h - 2 weeks

Sampling, Size, Representative

Extraction, Enrichment

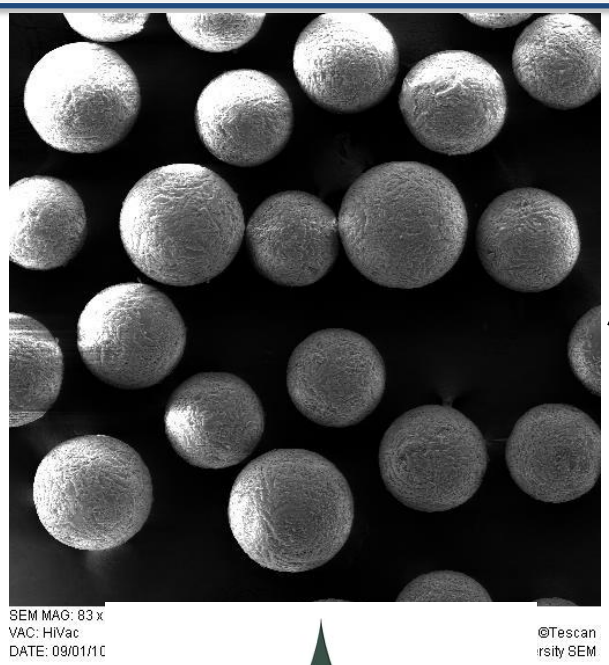
Particles
Distribution
Homogenous
Heterogenous
Heat sensitive
Light sensitive
Decomposition
Degradation

Sample Loss

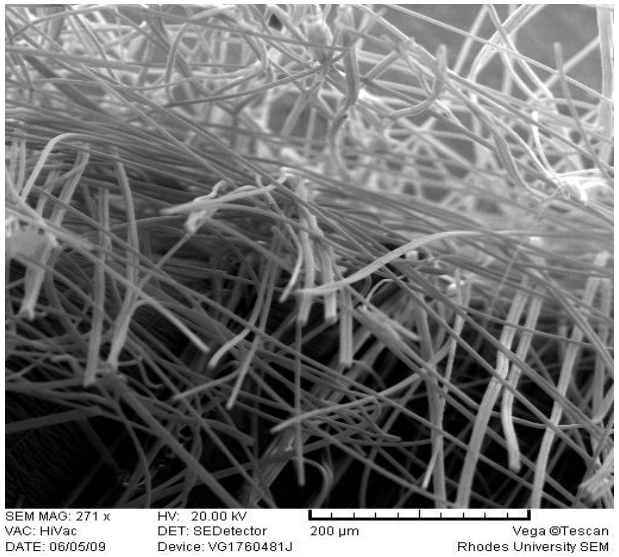
Coning
Contamination
Solubility
Quartering

Blending
Crushing
Milling
Cutting
Homogenizing
Pressing
Sieving
Mincing

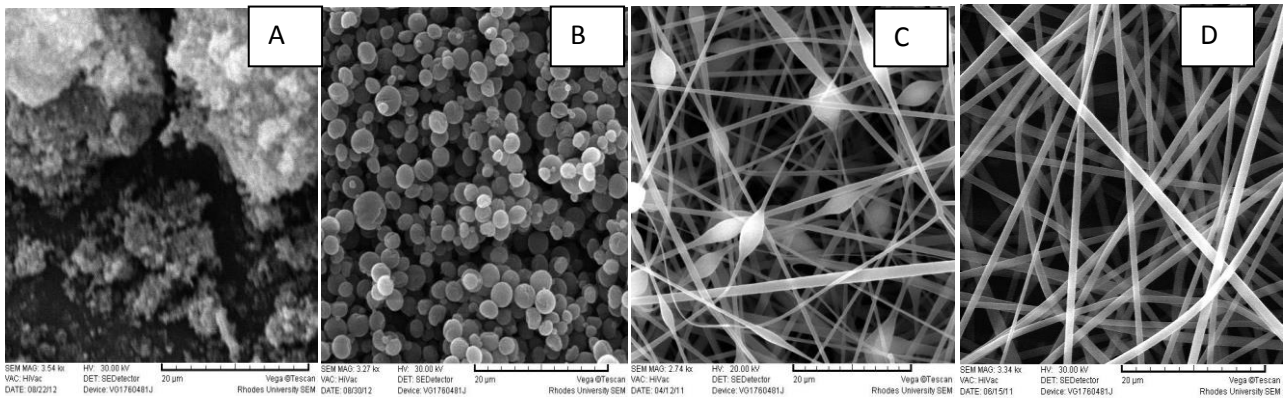
Microparticle

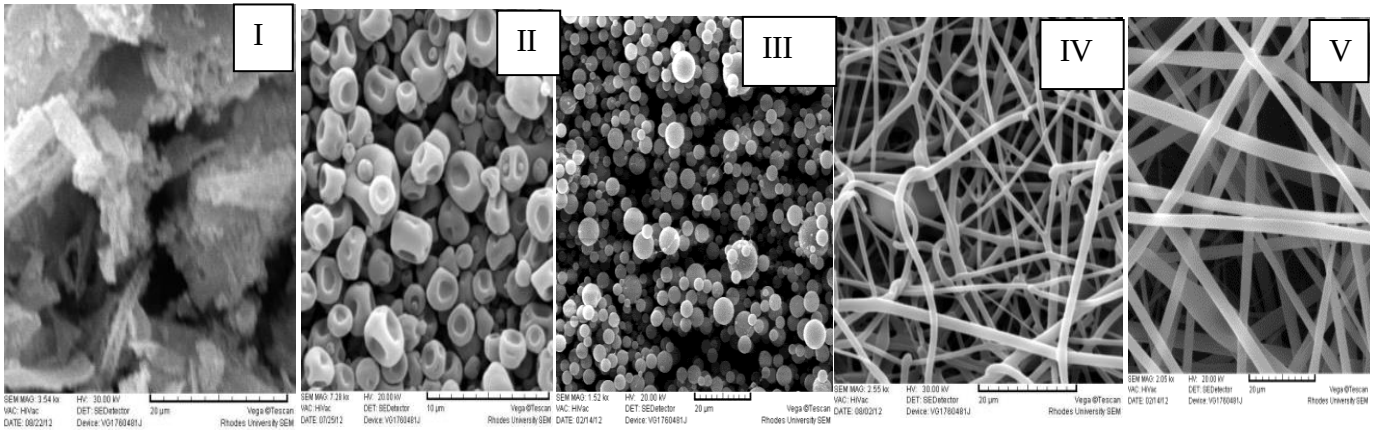


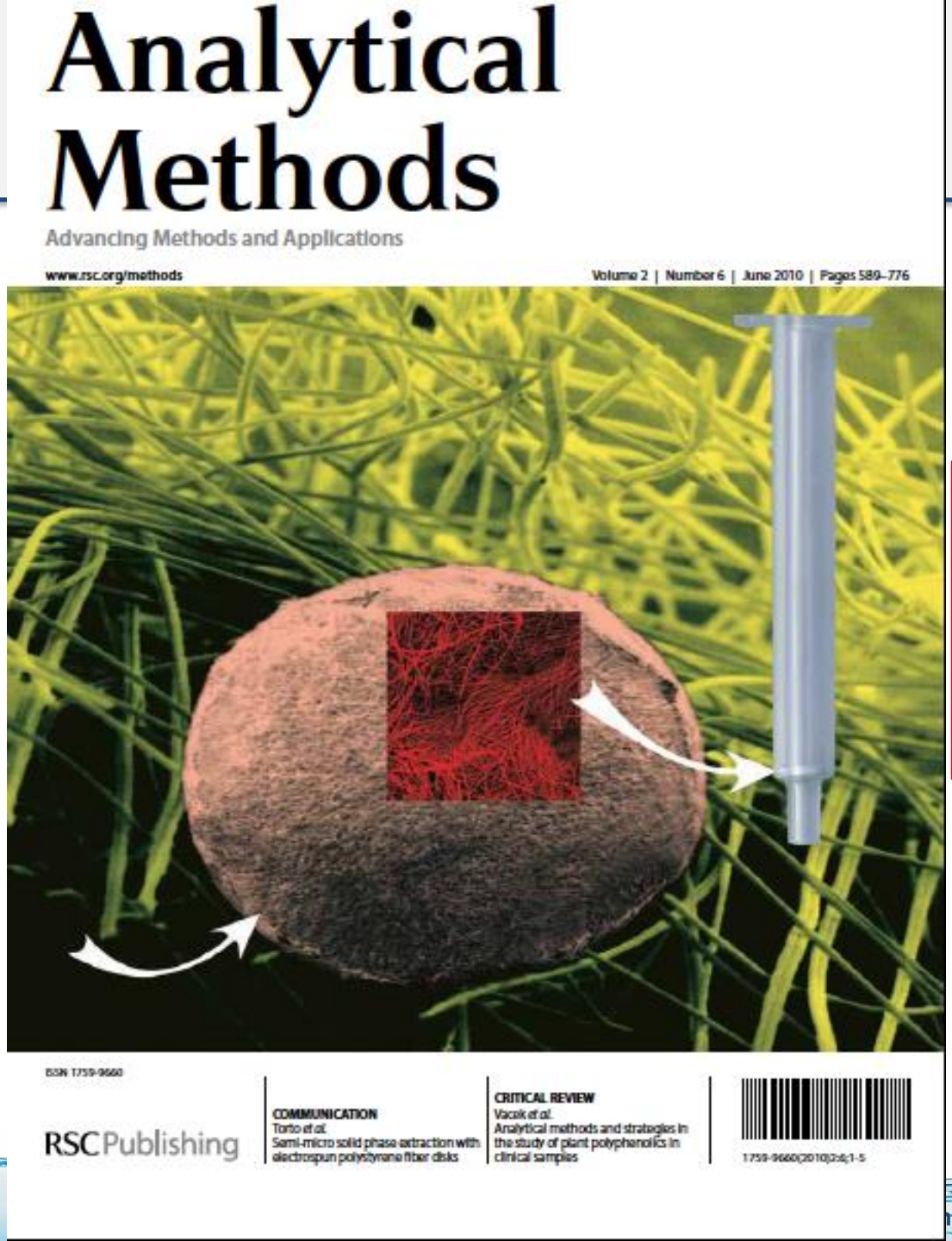
Electrospun nanofiber



Electrospun sorbents







a. Sample
b. Sorbent
c. Solvent

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Syntheses, characterization and antimicrobial activity of silver(I) complexes containing 2-hydroxymethyl-*N*-alkylimidazole ligands

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ABSTRACT

Silver(I) complexes $[Ag_2(L)_4](NO_3)_2$ were synthesized by the reaction of $AgNO_3$ with 2-hydroxymethyl-*N*-alkylimidazoles (**L**) (alkyl = benzyl, methyl, ethyl, propyl, butyl, heptyl, octyl and decyl) in ethanol at room temperature. The X-ray crystal structures of $[Ag_2(2\text{-hydroxymethyl-}N\text{-ethylimidazole})_4](NO_3)_2$ (**C2**) showed a dimeric $[Ag(L)_4](NO_3)_2$ and a monomeric $[Ag(L)_2]NO_3$ complex (L = 2-hydroxymethyl-*N*-ethylimidazole) in its unit cell, while $[Ag_2(2\text{-hydroxymethyl-}N\text{-benzylimidazole})_4](NO_3)_2$ (**C8**) showed only a dimeric complex $[Ag_2(L)_4](NO_3)_2$ (L = 2-hydroxymethyl-*N*-benzylimidazole). Both complexes displayed a slightly distorted linear N–Ag–N arrangement and the presence of Ag–Ag interactions in the dimeric complexes was due to the π stacking of the imidazole moieties. The antimicrobial properties of the Ag(I) complexes were investigated against *Escherichia coli*, *Staphylococcus aureus*, *Bacillus spizizenii* and *Candida albicans* by the disk diffusion and the broth microdilution methods. The Ag(I) complexes containing 2-hydromethyl-*N*-alkylimidazole ligands with shorter alkyl chain length were predominantly active against *E. coli*. The complexes containing ligands with longer alkyl chain length displayed predominant activity against *B. spizizenii*. The broad spectrum antimicrobial activity displayed by these silver(I) complexes makes them potential alternatives to the commercially available antimicrobial agents.

1. Introduction

Silver and its salts has been used as antimicrobial agents for many centuries [1,2]. Silver has the most superior properties among all metals with antimicrobial activity because of its higher toxicity to microorganisms and lower toxicity to mammalian cells [3,4]. Ionic silver is reportedly the active species while metallic silver is inert [5]. The ancient Phoenicians used silver-coated containers to store water so as to prevent spoiling [6]. The storage of water in silver-coated containers aided in the prevention of contamination by microorganisms. It was also reported that aqueous silver nitrate was used as an eye drop to newly born babies for the prevention of *Neisseria gonorrhoeae* transmission from infected mothers [7,8].

There are several reported mechanisms by which silver acts on the microorganisms [7,9]. For example one mechanism has been described to involve the reversible binding of silver to the nucleotide bases of the bacterial DNA. The reversible binding of silver to the bacterial DNA results in the denaturation by displacement of hydrogen bonds between adjacent purines and pyrimidines [7]. Davis and Etris [10] proposed that the destruction of bacteria occurs through silver-catalyzed oxidation of sulfhydryl (S-H) moieties on the surface of the membrane. Atomic oxygen in the aqueous medium oxidizes Ag(0) to Ag(I) which readily reacts with adjacent S-H groups by replacing the hydrogens. Consequent coupling of these adjacent S-groups results in the formation of S–S bond, thereby blocking respiration and electron transfer.

Silver sulfadiazine was the first silver complex to be used as an antimicrobial agent [11,12]. It is currently clinically administered for the treatment of burn wounds. Due to the emergence of resistant microorganisms, new broad spectrum antimicrobial agents are necessary. Consequently, many silver complexes have been investigated for their antimicrobial activity [13–18]. Interestingly, silver complexes containing imidazole ligands have exhibited remarkable broad spectrum antimicrobial activity [19–25]. However, the antimicrobial activity of the silver complexes containing imidazole ligands is often entirely due to the Ag(I) metal ion [20,25,26], since these metal-free imidazole ligands possess no activity.

For example, Rowan et al. [20] reported a series of imidazole derivatives which displayed no antimicrobial activity when not in a coordination sphere while their corresponding silver complexes displayed better activity. It is desirable, therefore, to synthesize silver complexes containing antimicrobially active imidazole ligands. It is also worth noting that the purpose for the preparation of silver sulfadiazine, mentioned above, was to combine an

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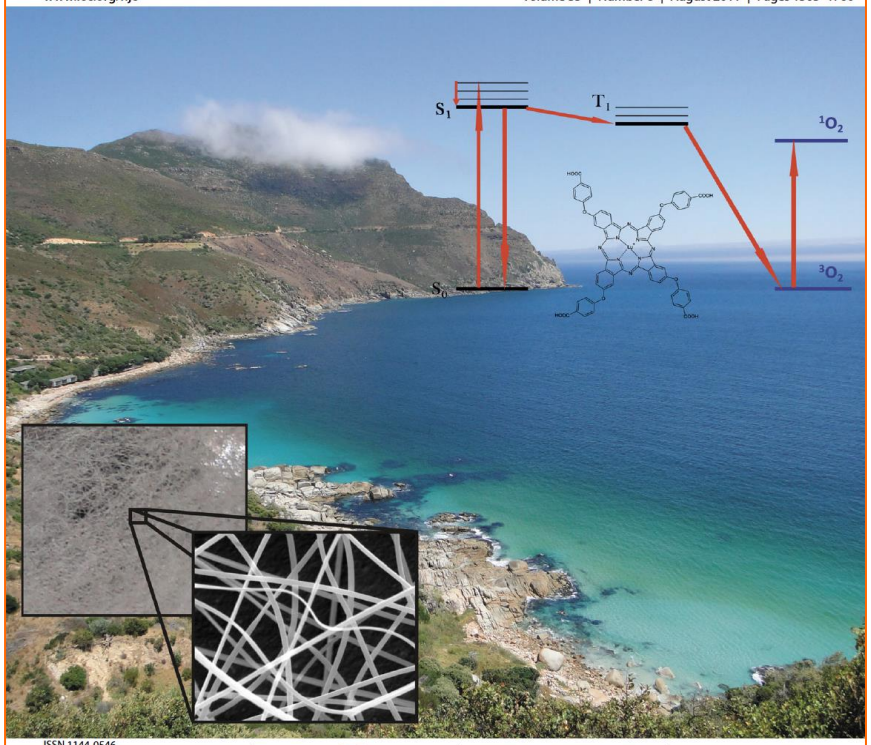

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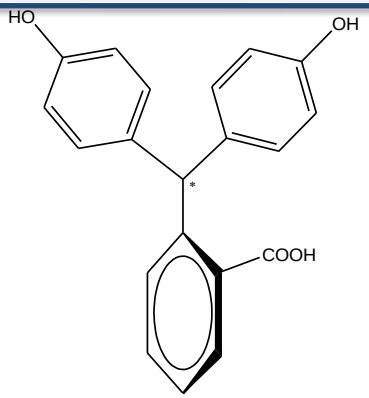
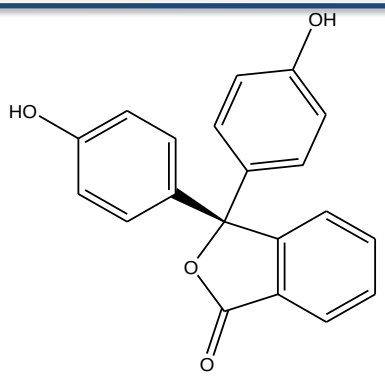
Chemical reactions

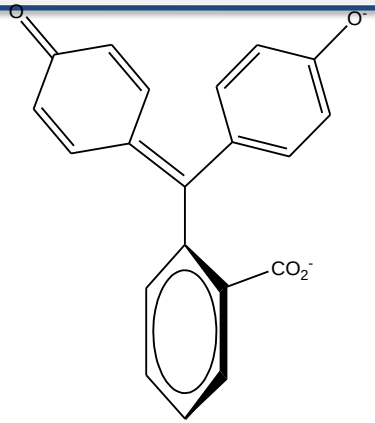
Phenolphthalein Chemistry



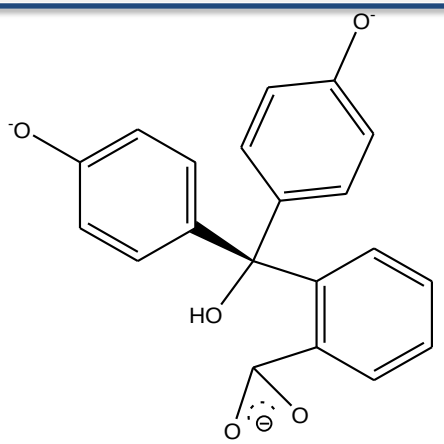
pH less than 0, strongly acid, orange colour



pH 0-8.2, acidic to near neutral, colourless

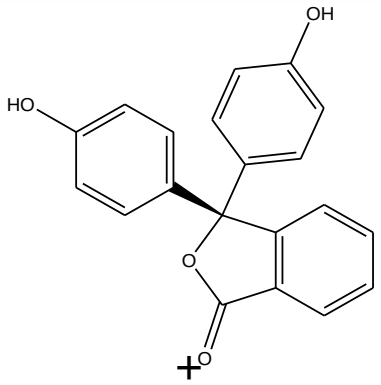


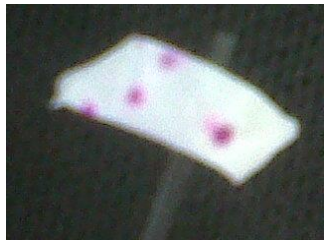
pH 8.2-12.0, basic, pink to fuchsia

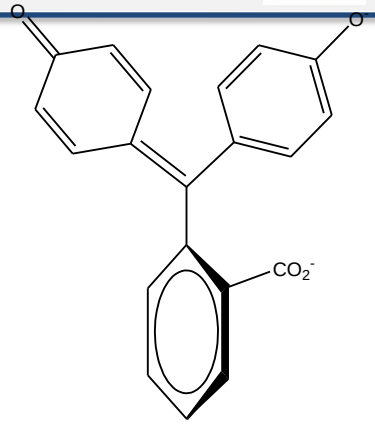


pH greater than 12.0, strongly basic, colourless

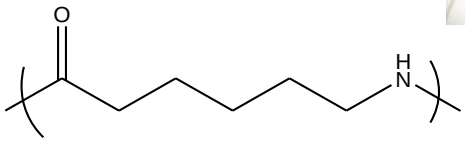
Nylon 6/Phenolphthalein

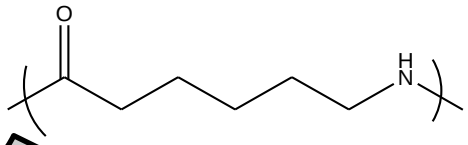






+

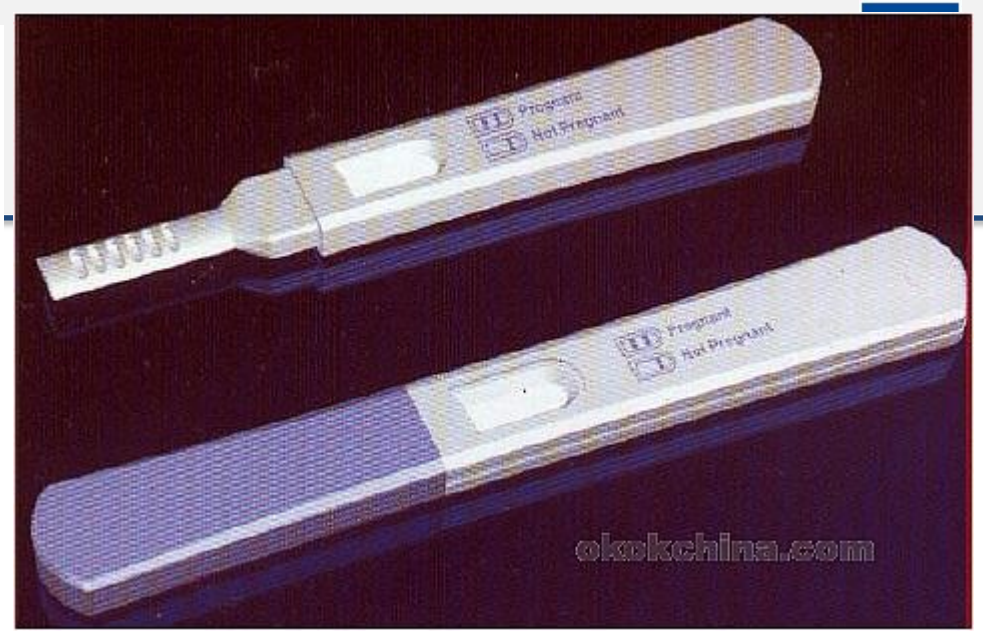




White fibers
(neutral solution)

Pink spotted
fibers
(Basic solution)

Pregnancy test

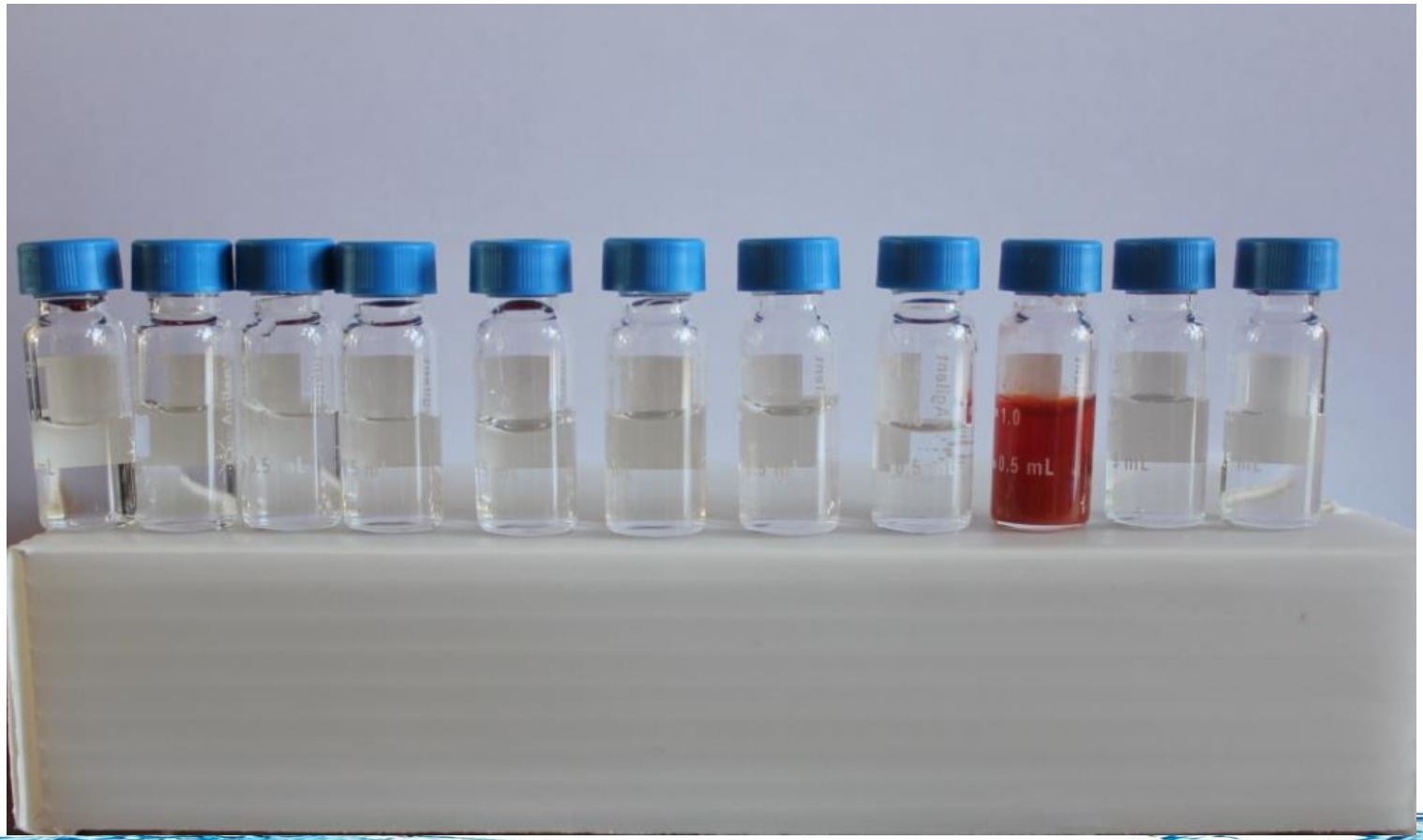


Pregnancy test

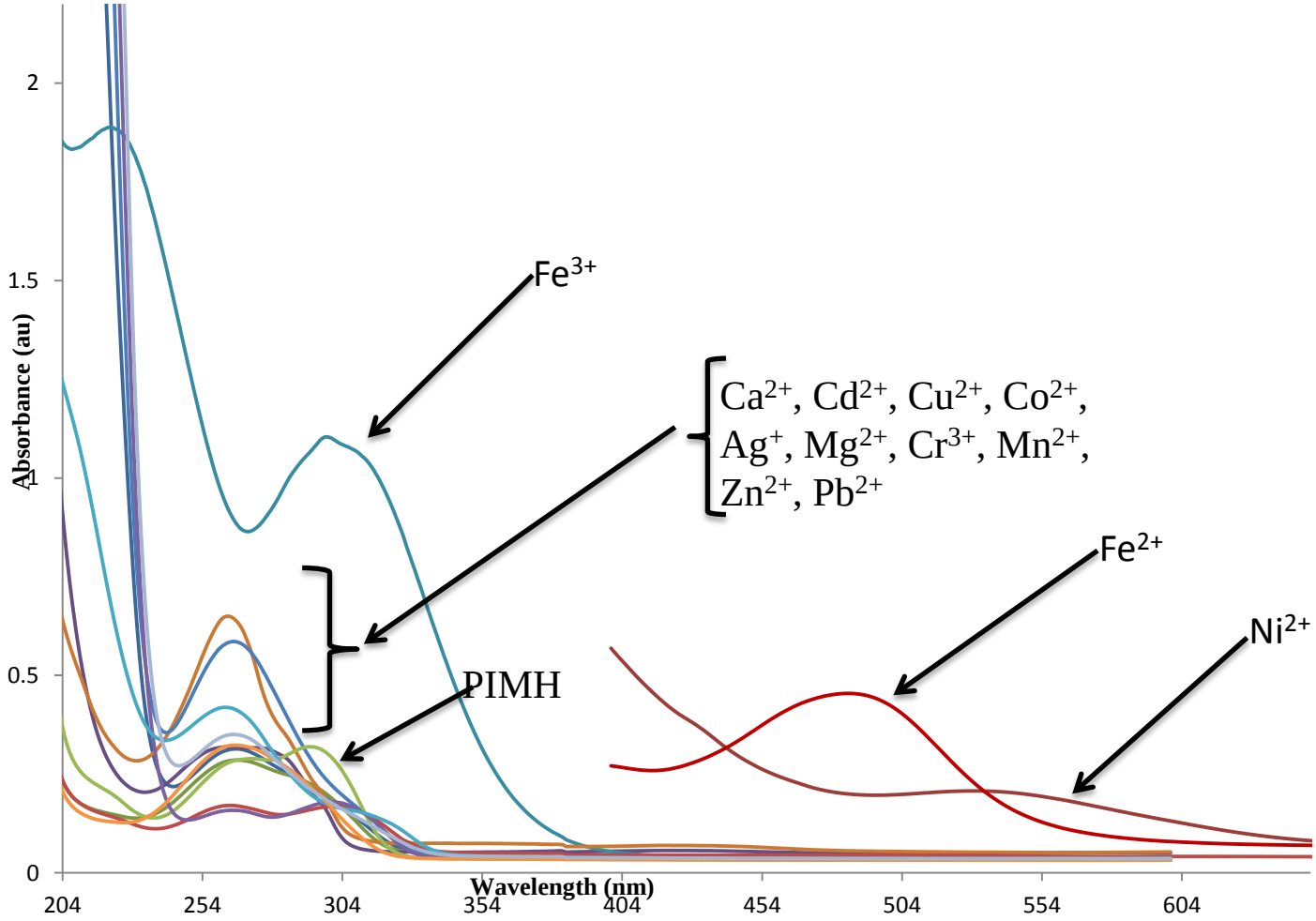
Multi-stick urine test

Colour changes for metals

Mn^{2+}, Ag^{+}, Cu^{2+}, Fe^{3+}, Mg^{2+} Pb^{2+},Cd^{2+}, Fe^{2+},Ni^{2+} , Zn^{2+}



Spectrophotometric Characterization

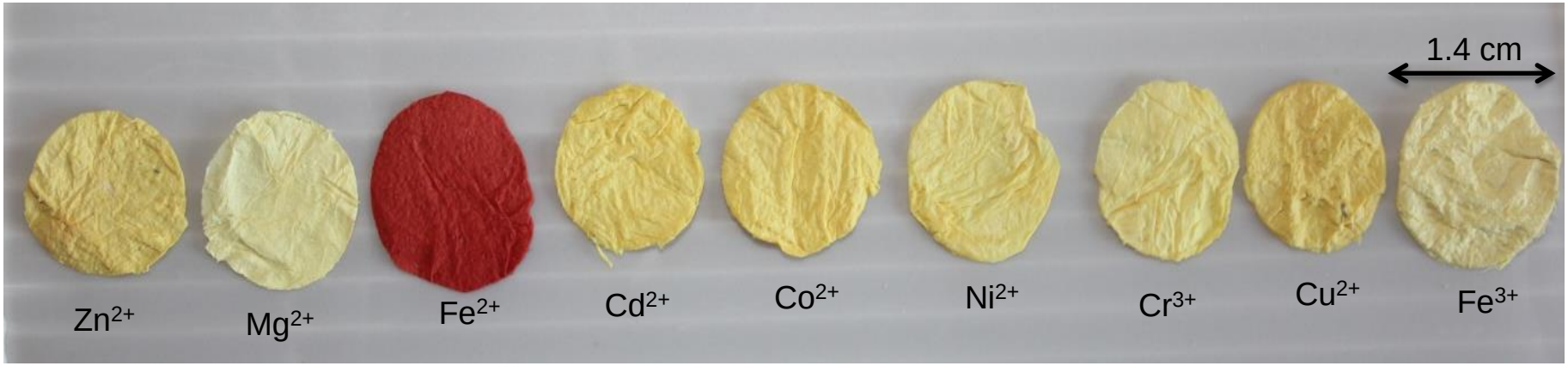


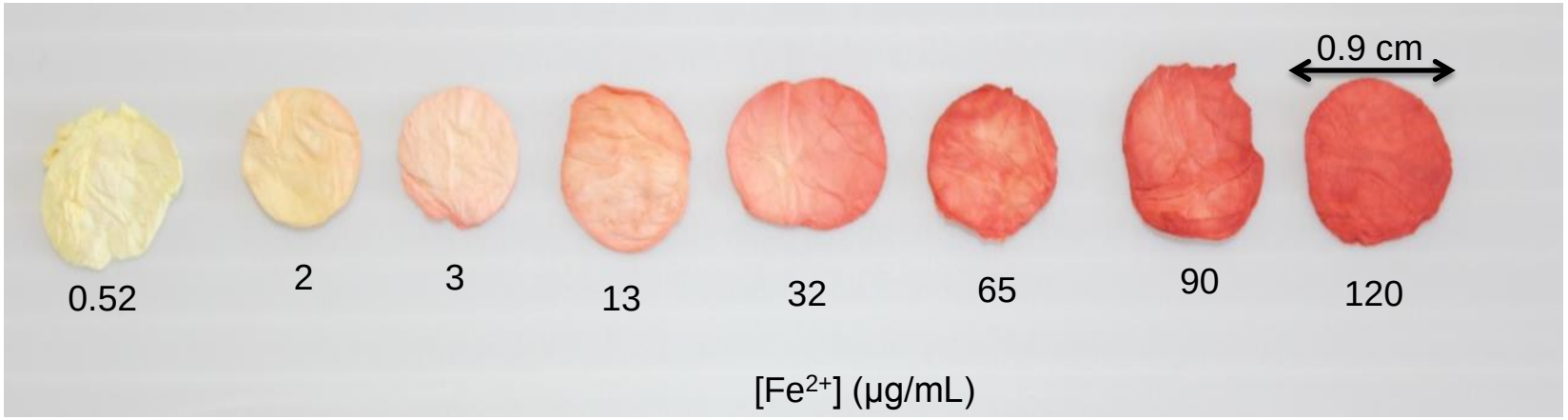
Metal Screening Studies

H_2O, Pb^{2+}, Ni^{2+}, Fe^{2+}, Na^{+}, Cr^{3+}, Ca^{2+}, Mn^{2+} Co^{3+}

Response and Sensitivity Studies

0.001 M solutions of metals



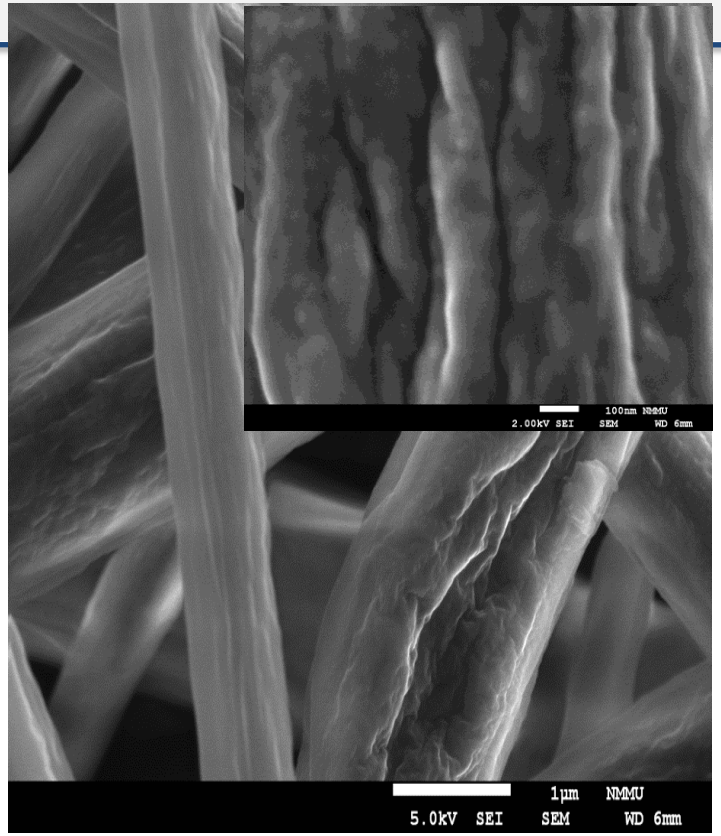


Metal nanoparticles probes

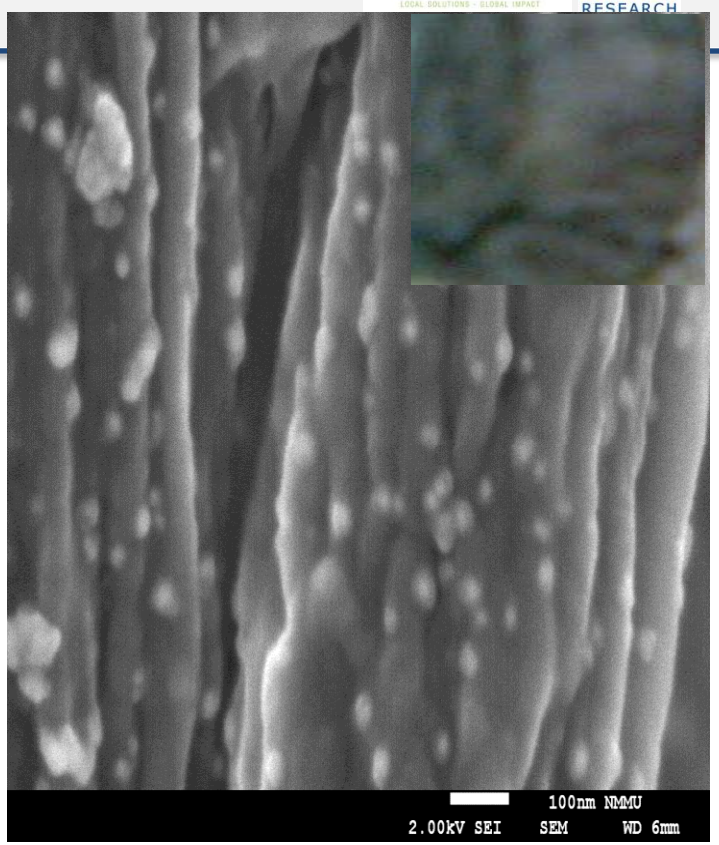
Metal salts

$NaBH_4$,Ligand

Interaction of probe with analyte



analyte



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Thank you