FIBROUS TITANIUM PHOSPHATE FUNCTIONALIZED WITH BIOSYNTHESIZED AgNPs FOR OPTICAL SENSING AND ANTIMICROBIAL ACTIVITY

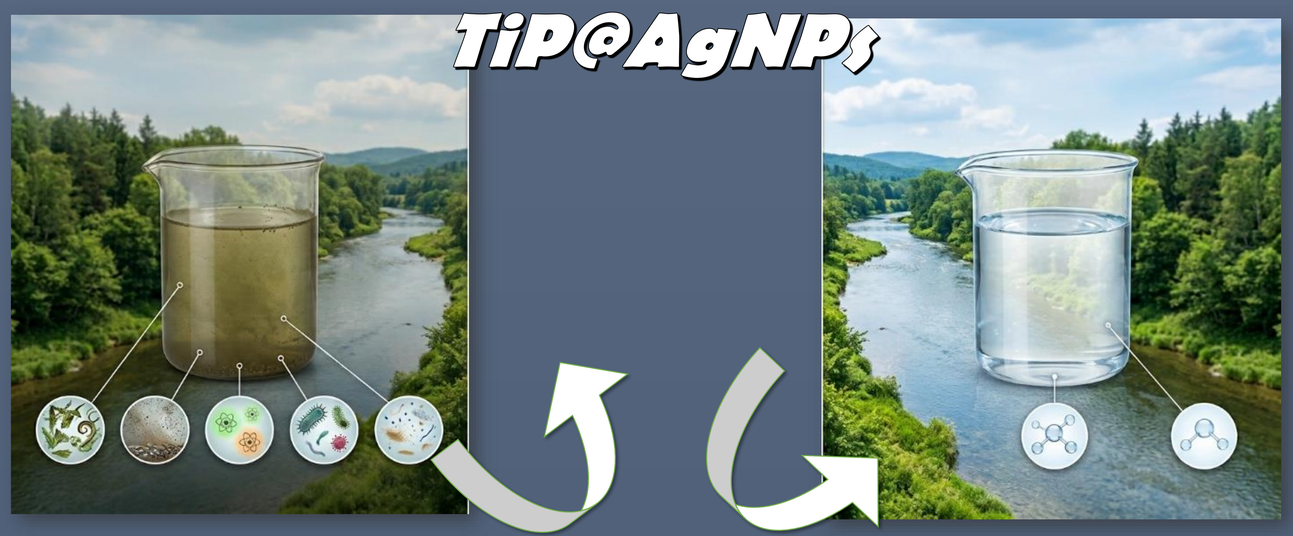
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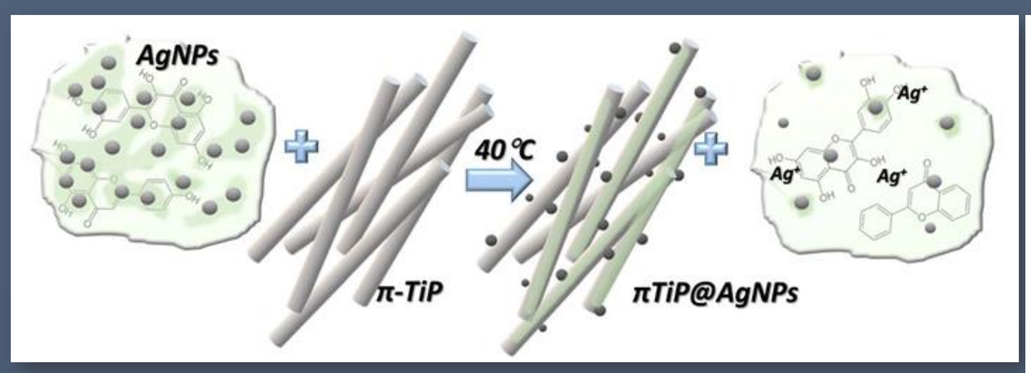
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The environmental remediation of wastewater has remained a primary concern for researchers over the past few decades. Hazardous materials found in drinking water can be classified as organic, inorganic, radioactive, biological, physical, etc. The presence of heavy metal pollutants in the environment is an ever-present issue in modern life, is exacerbated by rapid modernisation and industrialization. Among various inorganic frameworks, fibrous titanium phosphate (TiP) stands out as a support matrix due to its high surface area, ion-exchange capacity, and stability. These structural attributes make it an ideal matrix for the impregnation of functional guest species, such as silver nanoparticles (AgNPs), which are renowned for their potent biocidal and remediation properties.

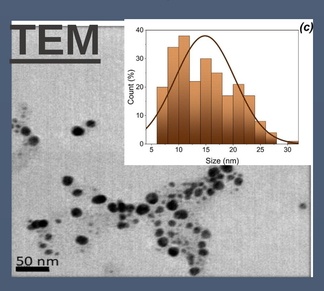


Preparation and Characterization of multifunctional nanocomposite (TiP@AgNPs)

AgNPs: *Melisa extract (70 %) was added to AgAc 10 mmol/l solution under magnetic stirring at room temperature*



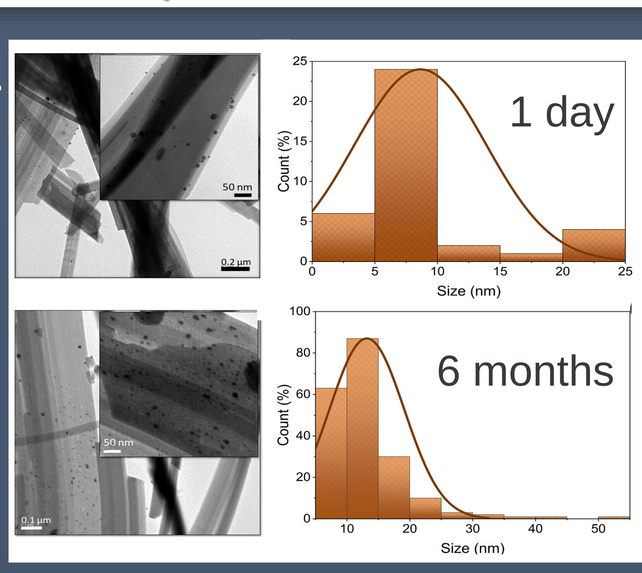
TEM



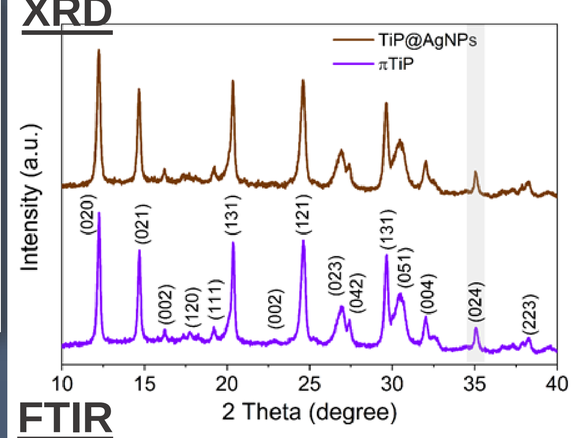
*The **π-TiP** solids were prepared via the sol-gel method followed by hydrothermal treatment at 180 C using the reaction between 2M $TiCl_4$ and 1.6M H_3PO_4*

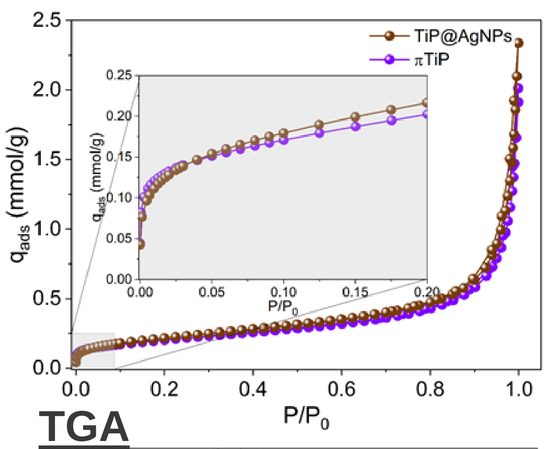
Titanium Phosphate Nanocomposite (TiP@AgNPs): *The **π-TiP** fibers were mixed with prepared solutions of AgNPs. Then the mixtures were in an ultrasonic bath and left at 40° C. The obtained samples were filtered, washed thoroughly with distilled water, and dried at 60° C.*

TEM

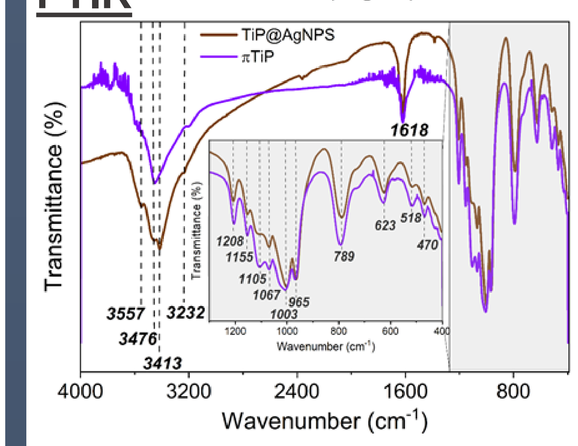


XRD

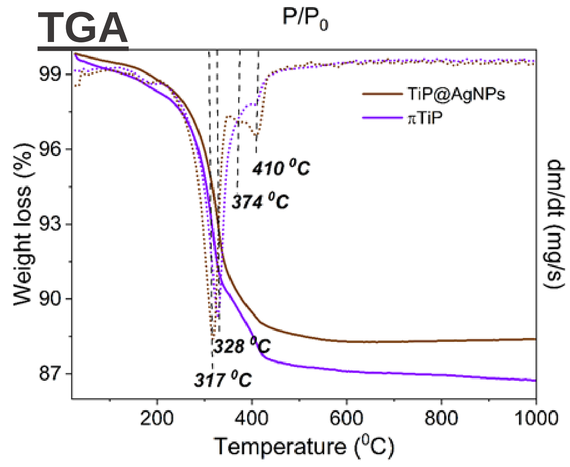




FTIR



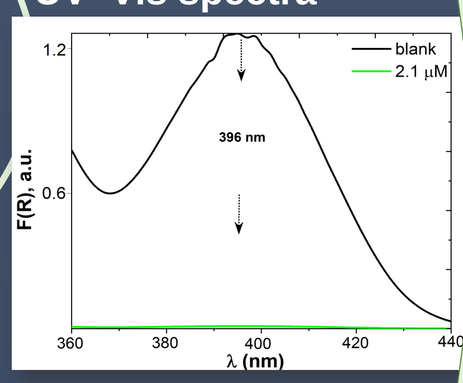
TGA

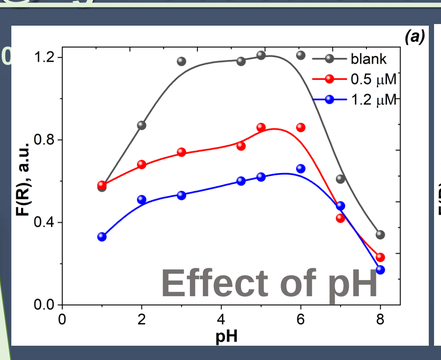


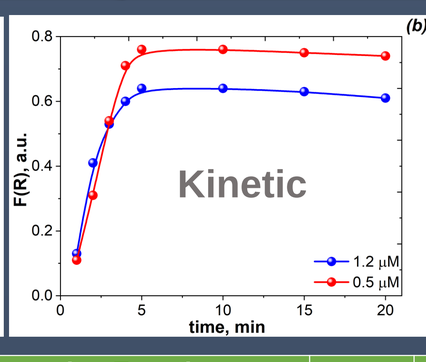
TiP@AgNPs as sensors for Hg^{2+} ions detection

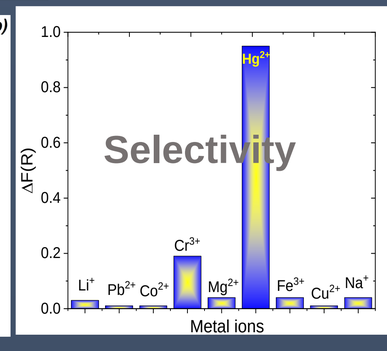
$2Ag^0 + Hg^{2+} \rightarrow 2Ag^+ + Hg^0$

UV–Vis spectra





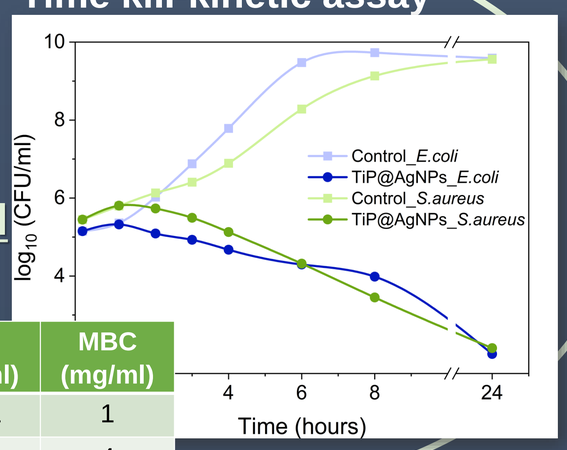




Sample	Regression Equation $F(R) = (a \pm S_a)\cdot C(Hg^{2+}) + (b \pm S_b)$		R^2	Linearity, μM	LOD, μM	LOQ, μM
	$a \pm S_a$	$b \pm S_b$				
Doble distillated water	-0.5911±0.0030	1.1882±0.0056	0.9996	0.05-2.00	0.030	0.100
Ultrapure water (or deionized water)	-0.7684±0.0042	1.4513±0.0058	0.9998		0.025	0.083

Antibacterial tests

Time kill-kinetic assay



	MIC (mg/ml)	MBC (mg/ml)
E. coli	0.5-1	1
S.aureus	1-2	4

Conclusions:

- ✓ The effective and cheap inorganic nanocomposite based on fibrous titanium phosphate with embedded AgNPs (TiP@AgNPs) was first developed for potential multifunctional environmental applications.
- ✓ The AgNPs were prepared by "green" synthesis using CH_3COOAg solution and Melissa officinalis extract (EtOH, 70 %). The size of biosynthesized AgNPs is estimated to be ~ 15-18 nm according to the TEM method. AgNPs could be stored for more than 1 year at room temperature.
- ✓ The TiP@AgNPs nanocomposite was prepared by in-situ treatment of nanofibres with biosynthesized AgNPs. TEM data of TiP@AgNPs show that the AgNPs are distributed uniformly and monodispersely across the surface of fibres.
- ✓ The TiP@AgNPs nanocomposite exhibited potent antibacterial activity against both Gram-positive (*S. aureus*) and Gram-negative (*E. coli*). The Gram-negative strain proved more susceptible, with MIC and MBC of 0.5-1.0 mg/mL and 1.0 mg/mL, respectively.
- ✓ TiP@AgNPs were used as sensors for Hg^{2+} ions detection in both double-distilled and deionised waters, the limits of detection (LOD) were determined to be 0.030 μM and 0.025 μM, respectively, within a wide linear range (0.05–2.00 μM).
- ✓ Thus, the as-prepared nanocomposite demonstrates multifunctionality as a highly sensitive sensor for Hg2+ ions detection in various water matrixes and a potent antibacterial agent.

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