DAB-NANOTRAP

Low cost nanoTraps for water purification

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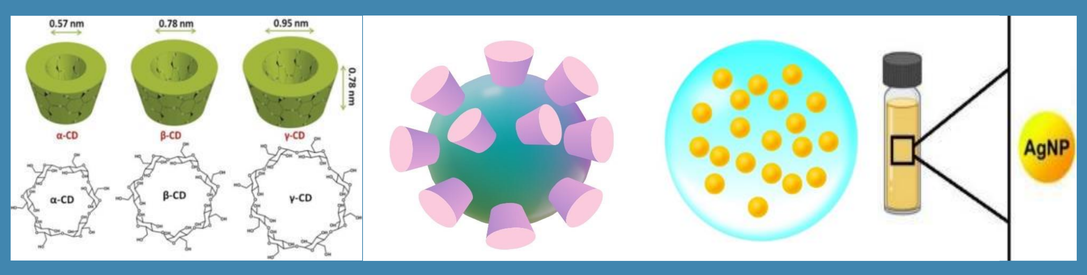
PROBLEM ANALYSIS

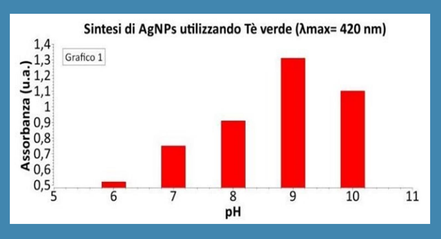
Ensuring clean water for a constantly growing global population is one of the most urgent challenges worldwide. Traditional approaches based on chemical, physical, and biological treatments (such as coagulation, filtration, and activated sludge) are often insufficient to remove emerging contaminants (such as pharmaceuticals, personal care products, pesticides, and PFAS).

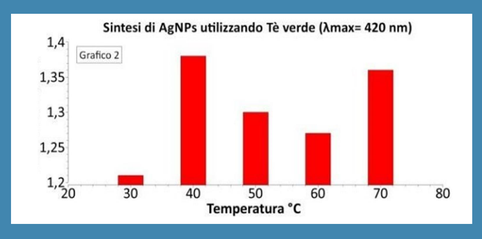
NANOTECHNOLOGY STRATEGY

Our project, utilizing supramolecular chemistry and nanotechnology, proposes a new low-cost and green strategy for capturing water pollutants through the creation of molecular traps.



EFFECTS OF REACTION PARAMETERS

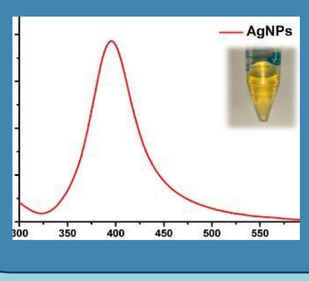


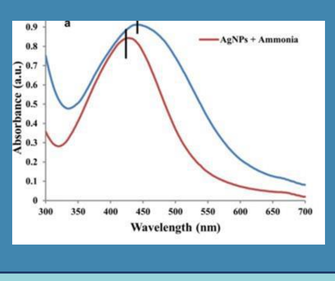


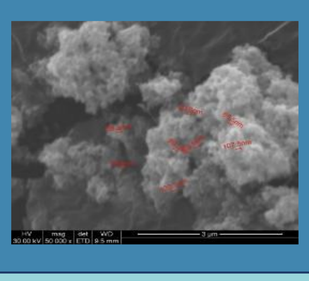
- **The influence of pH, temperature, tea concentration, quercetin concentration, and AgNO3 concentration on the synthesis of AgNPs was studied using UV-visible spectroscopy and DLS.**
- **The obtained AgNPs-βCD nanoparticles were characterized using UV-visible spectroscopy, SEM and DLS.**

DATA ANALYSIS

- **The UV-Vis spectra of the silver nanoparticles show a plasmonic peak at 404 nm. The encapsulation of AgNPs in alginate bubbles causes a broadening of the plasmonic band, which shifts to the red at 420 nm (red shift).**

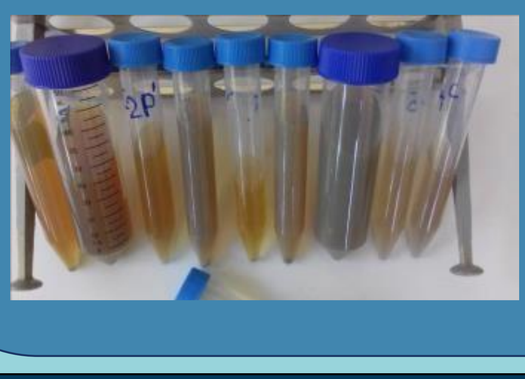


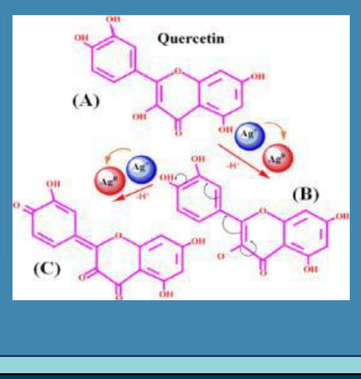




SILVER NANOPARTICLES

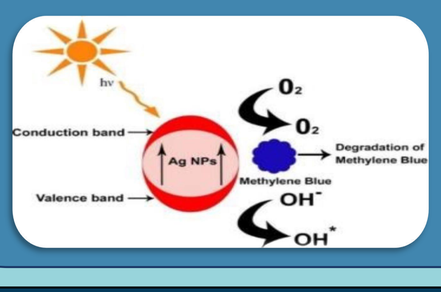
We have created a multifunctional plasmonic hydrogel composed of silver nanoparticles (AgNPs) (precursor AgNO3 0.1M-2mM) using plant-based reducing agents such as green tea polyphenols and quercetin extracted from onions. These substances also act as stabilizing and protective agents for the produced nanoparticles (with a diameter of 60-80nm).





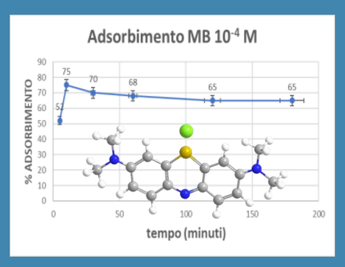
SYNTHESIS OF NANOTRAPS

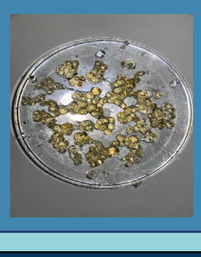
The AgNPs were functionalized with β-cyclodextrins (concentration 0.1 - 0.2M), which act as molecular receptors, and characterized using UV-visible spectroscopy and DLS. However, due to their ecotoxicity and cytotoxicity, AgNPs cannot be dispersed into the environment. For this reason, they were encapsulated within bubbles of sodium alginate and Ca^{2+} (2.5M), which attract contaminated water.

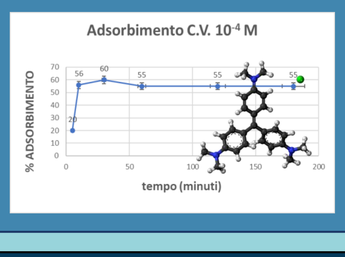


POLLUTANT CAPTURE TESTS

"The absorption kinetics are very fast. More than 50% of MB is adsorbed within one minute. The maximum absorption (corresponding to ~75% of MB) is reached within 5 minutes."







COST ANALYSIS

- ✓ **Green raw materials account for 10% of total costs.**
- ✓ **30% of the costs are attributable to the steps in the synthesis process.**
- ✓ **most of the costs are due to the filtration and regeneration cycles of the bubbles.**
- ✓ **1 liter of purified water has a cost of about 3 euros**

CONCLUSIONS

Dab-nanotrap reported excellent results for the adsorption of methylene blue and Cristal violet. In contrast, the application of AgNPs-βCD-alginate bubbles requires more experimentation for the adsorption of other molecules including some pesticides present as contaminants in our agricultural areas.

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