CRYOGENIC APPROACH FOR PRODUCTION OF BIOMEDICAL NANOCOMPOSITES: ANTIBACTERIAL DRUG DIOXIDINE WITH SILVER NANOPARTICLES

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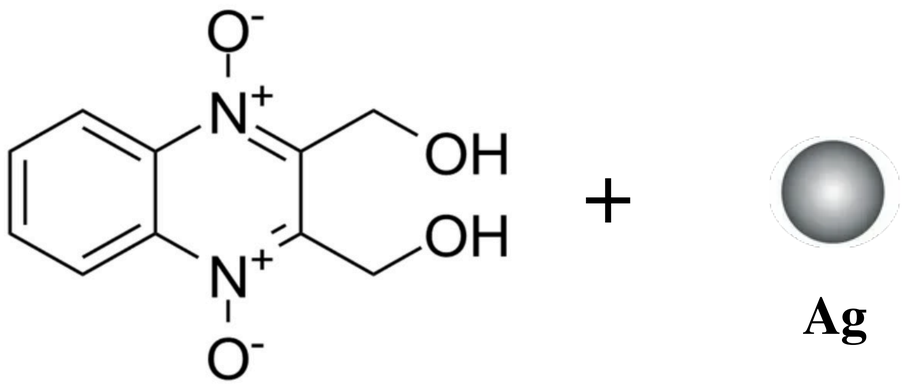
Crystalline biomedical nanocomposites

This is a new, cheaper and more affordable approach, which consists in improving old medicines instead of inventing new ones



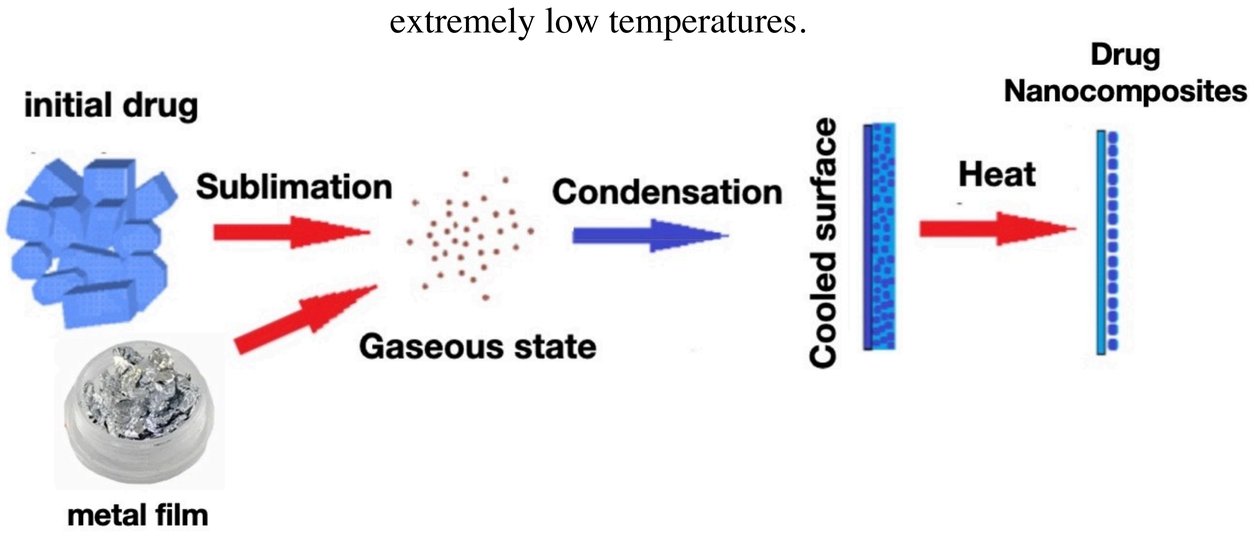
Dioxidine antibacterial drug + Ag NPs

- Small particle size (extensive specific surface area)
- Metastable crystalline forms
- Creating a composite structure of drug-metal

- Increase in saturation solubility for poorly soluble drugs
- Increase in dissolution rate
- Drug delivery to the cell by a mechanism of endocytosis
- Use of small doses of drug (reduction of side effects)
- Increase in bioactivity

Cryogenic method for production nanocomposites

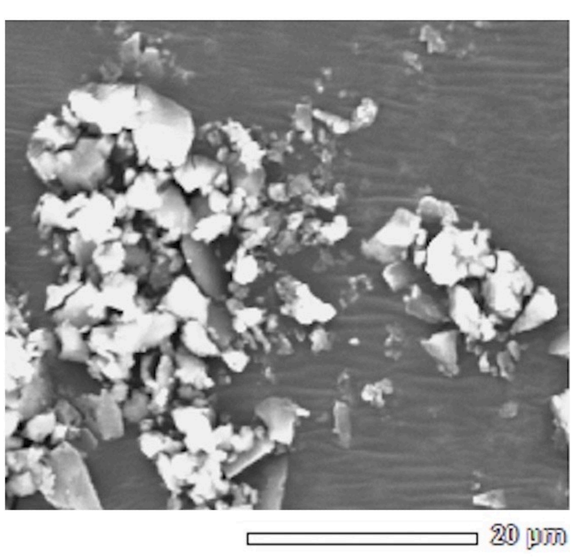
Cryogenic bottom-up method is based on creation of supersaturation due to extremely low temperatures.



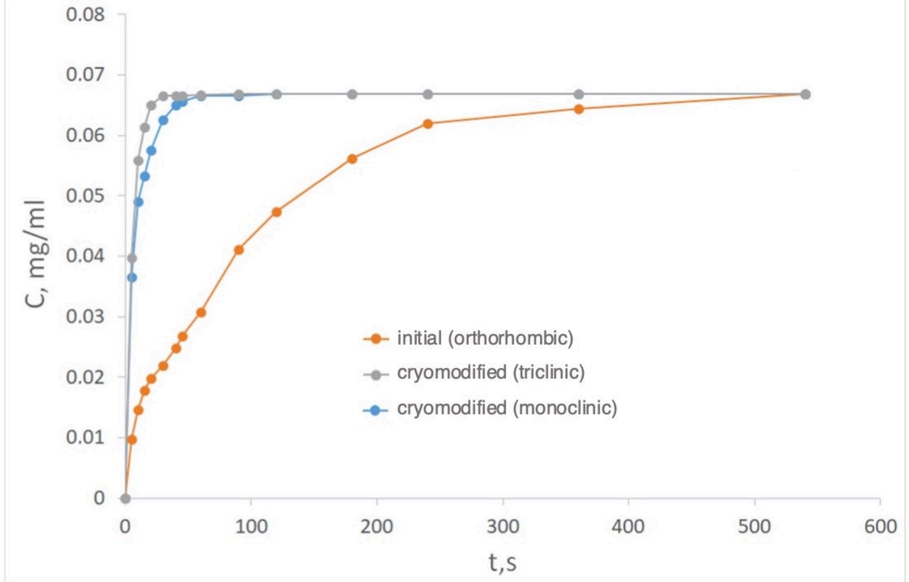
Main stages:

- Sublimation of the initial drug and metal with a heated grid
- Condensation of the drug+metal molecular beams on a cooled surface
- Crystallization and subsequent heating of the system to room temperature

Results

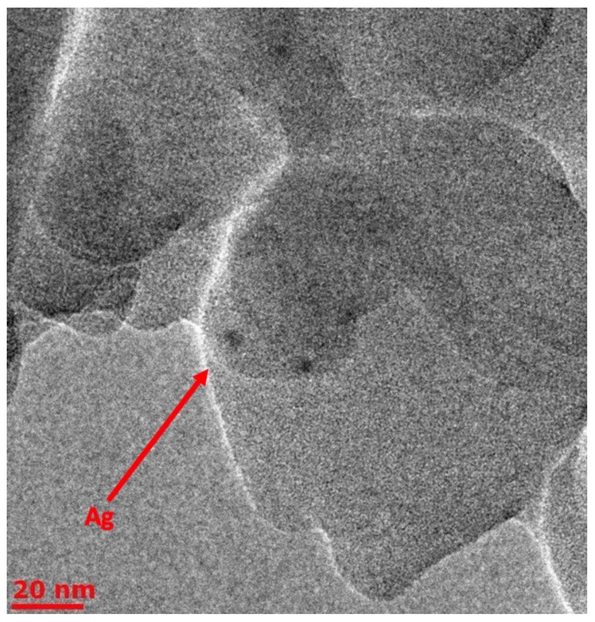


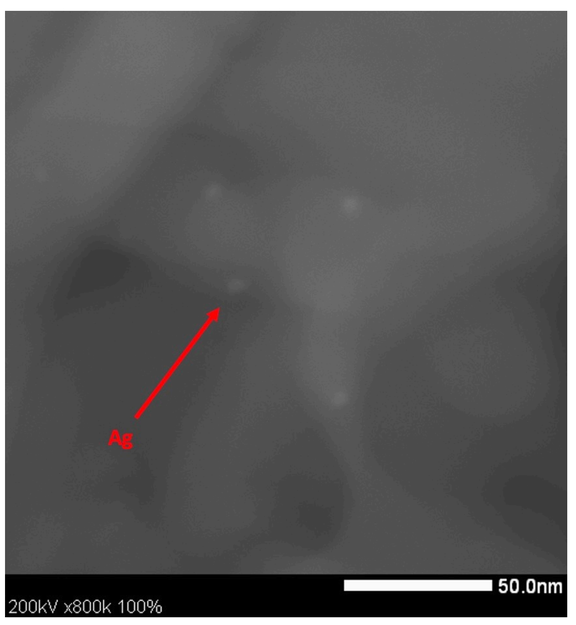
SEM microphotograph



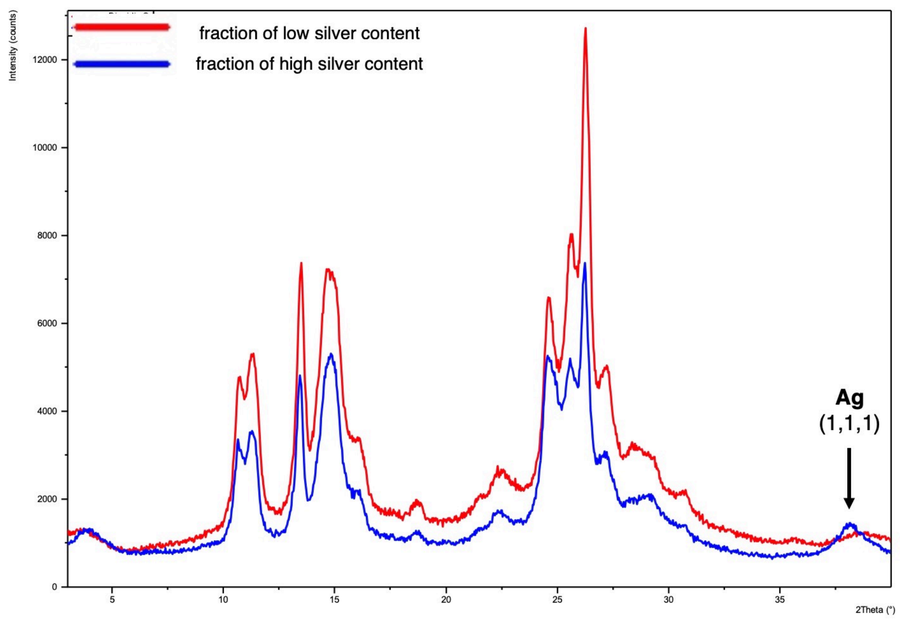
Dissolution kinetics plots

Results

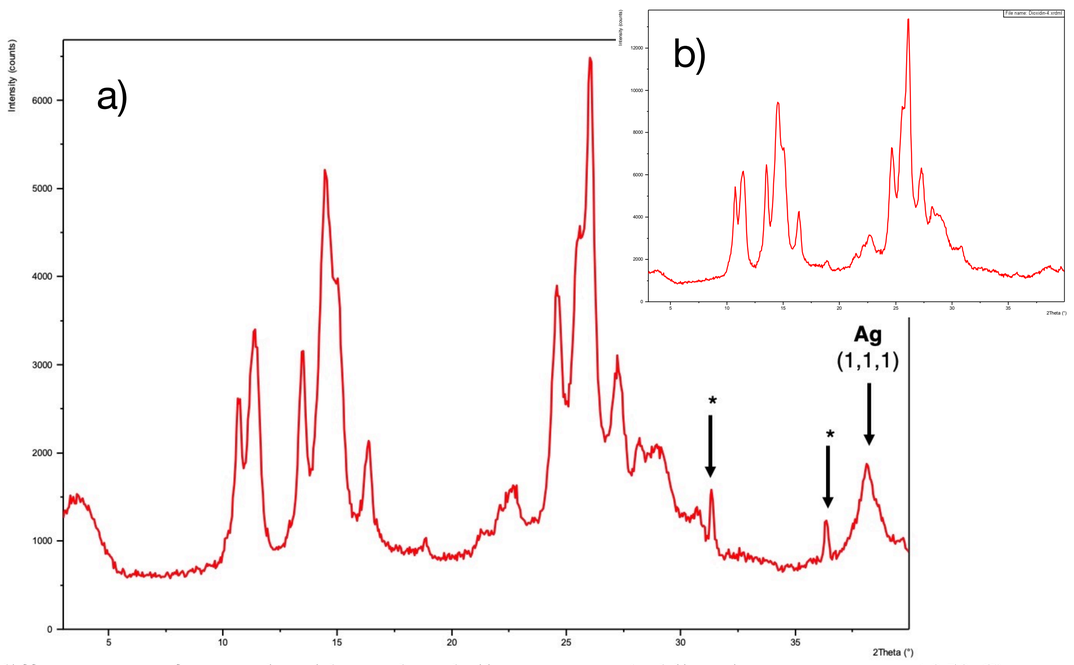




TEM microphotographs. The average Ag particle size is 3 nm.



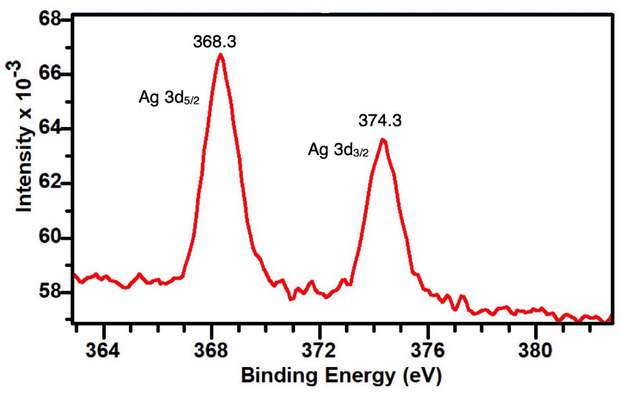
X-ray diffractogram of a sample with a high silver content (sublimation temperature 1100 C)



X-ray diffractogram of a sample with a reduced silver content (sublimation temperature 1050 C)

a) - fraction of low silver content, b) - fraction of high silver content

* - reflexes corresponding to the joint crystal structure of Ag and dioxidine.(2q = 31,2° and 2q = 36,2°)



XPS bands corresponding to metallic Ag(0)

Conclusions

- Dioxidine-Ag nanocomposites (the average particle size is 400 nm for dioxidine, 3 nm for Ag) were obtained by a new cryogenic technique
- According to XRD, dioxidine is present in a metastable triclinic form (the dissolution rate of which is increased). In a sample with a low silver content, the formation of a joint crystal structure of dioxidine and Ag occurs.