Gold nanoclusters as supramolecular probes for amyloid fibrils detection

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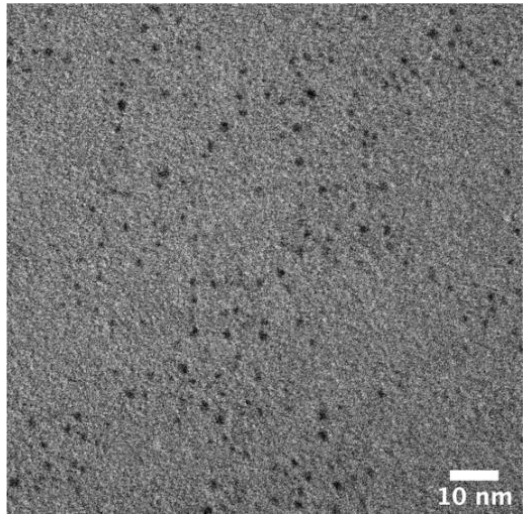

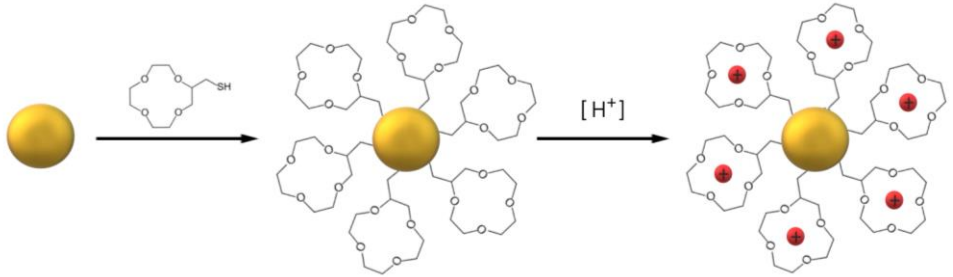

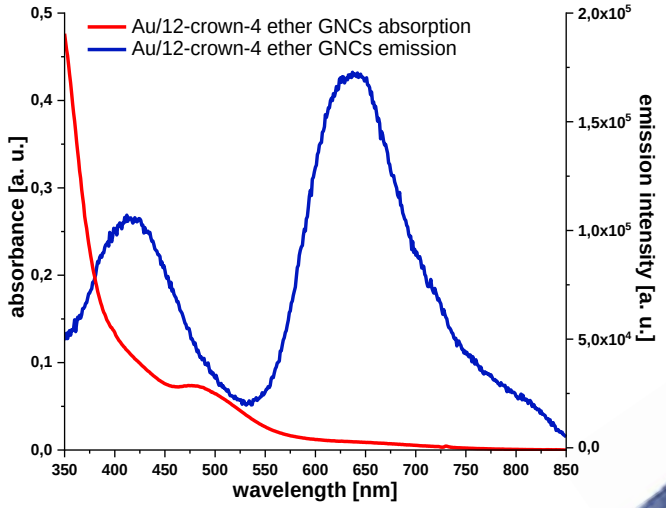

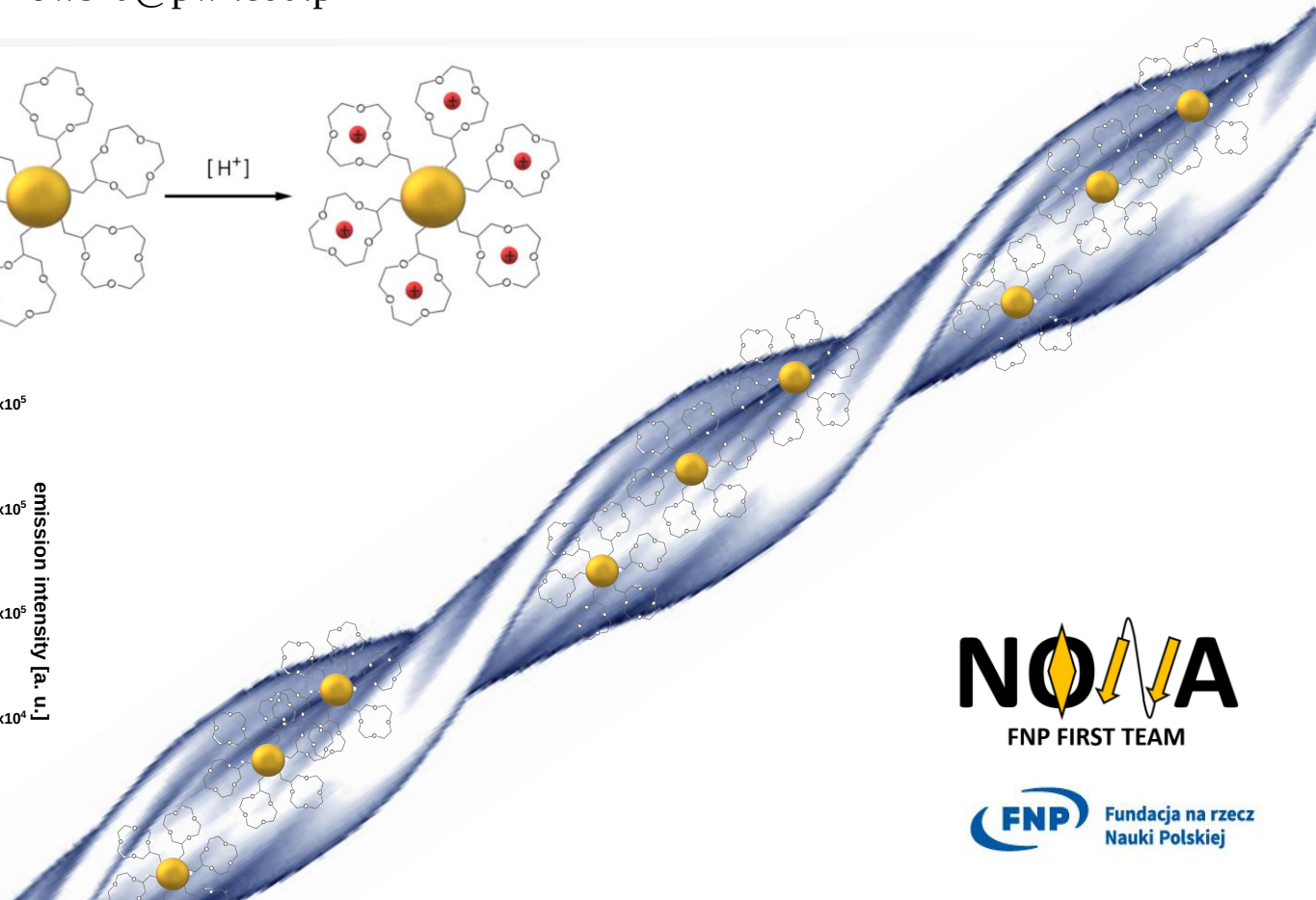

NOVA FNP FIRST TEAM

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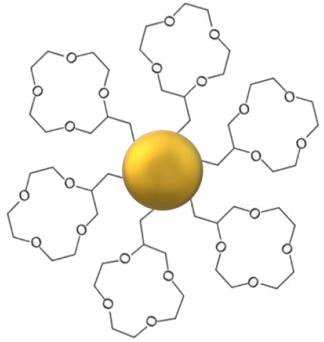
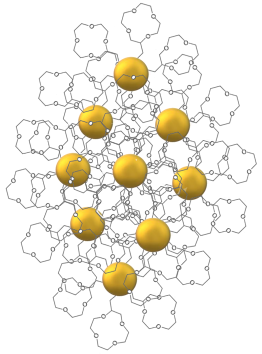


GENERAL CONCEPT

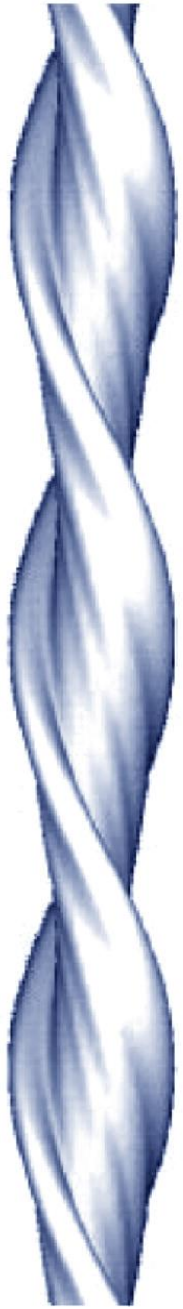
THE USE OF FLUORESCENT GOLD NANOCLUSTERS (GNCs)
AS PROBES FOR AMYLOIDS FIBRILS DETECTION



Amyloids –proteins, which tends to misfold and aggregate into elongated β-sheet rich polymeric structures.

The process of amyloid formation is **pathologically associated with neurodegenerative diseases** (e.g. Parkinson's disease, Alzheimer's disease)
→ it is crucial to study amyloids fibrillation, their detection, toxicity etc.

Aim of the study: Self assembly of GNCs along amyloid fibrils – detected by UV/VIS spectroscopy and TEM microscopy



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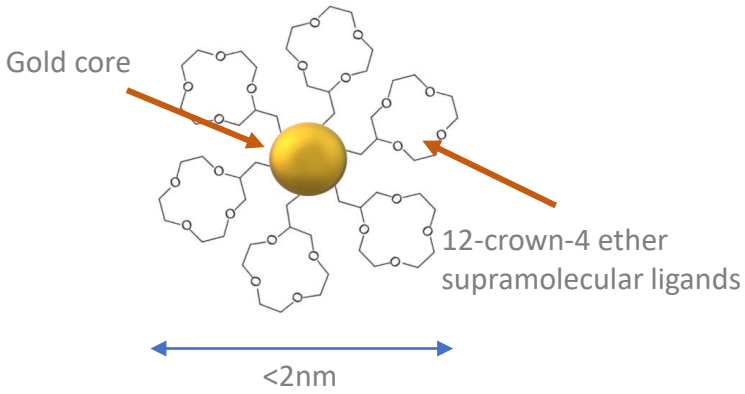

Motivations for using crown ether-GNCs

- Strong fluorescence → quick and fast spectroscopic detection
- Ultra-small size of GNCs → ability to interact with protein fibrils
- Crown ethers cavities as supramolecular hosts for H^+ and NH_4^+ ions
- Changeable hydrophobicity

GNCs self-assembly along amyloids fibrils

in neutral conditions (pH=7) | in acidic conditions (pH<1)

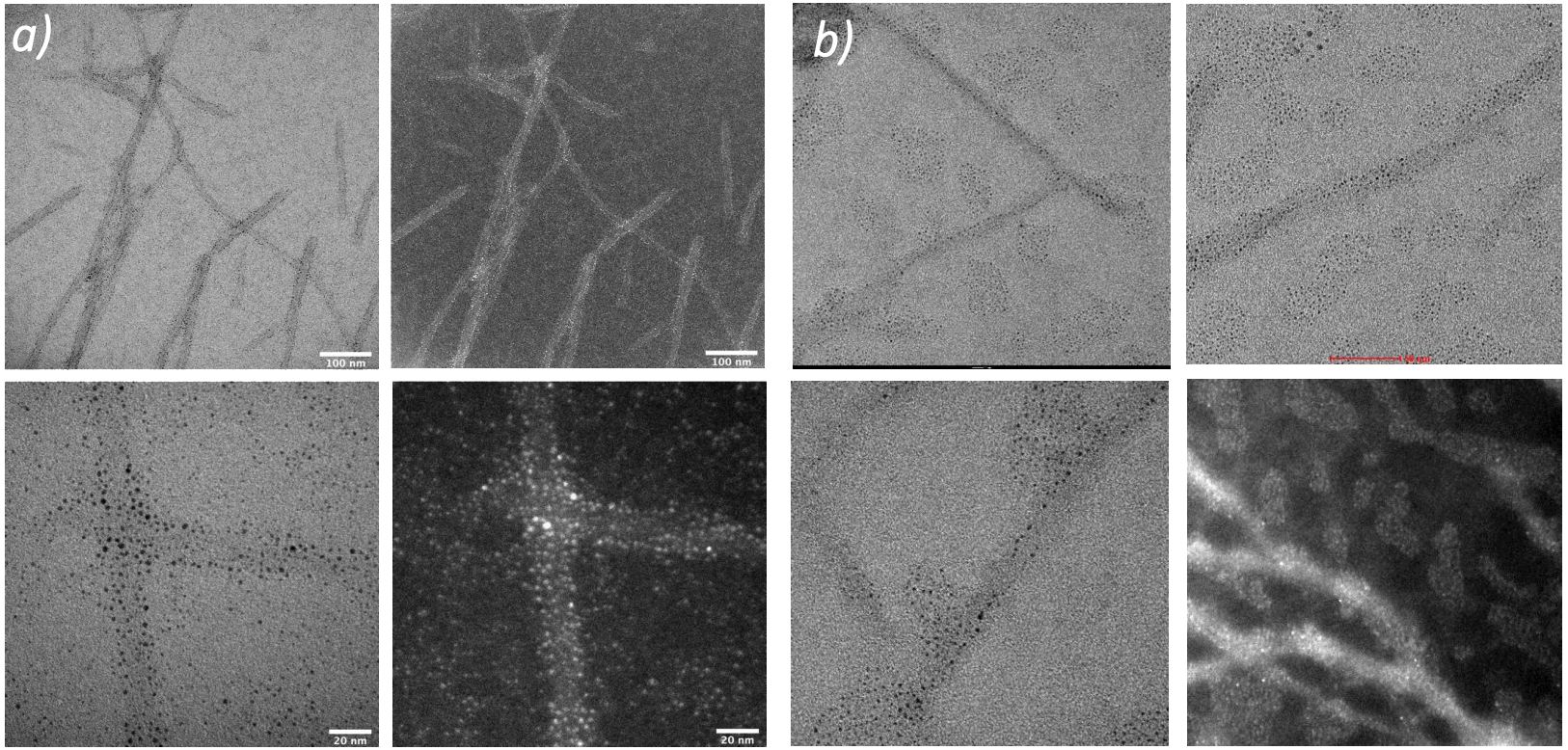

Fig. 1. Bright mode and Dark mode TEM images of amyloid fibrils incubated with Au/12-crown-4 ether NCs at a) neutral conditions (pH=7) and b) acidic conditions (pH<1)

Self-assembly caused by crown ether ligands **complexation**, which leads to **hydrophobicity** of GNCs

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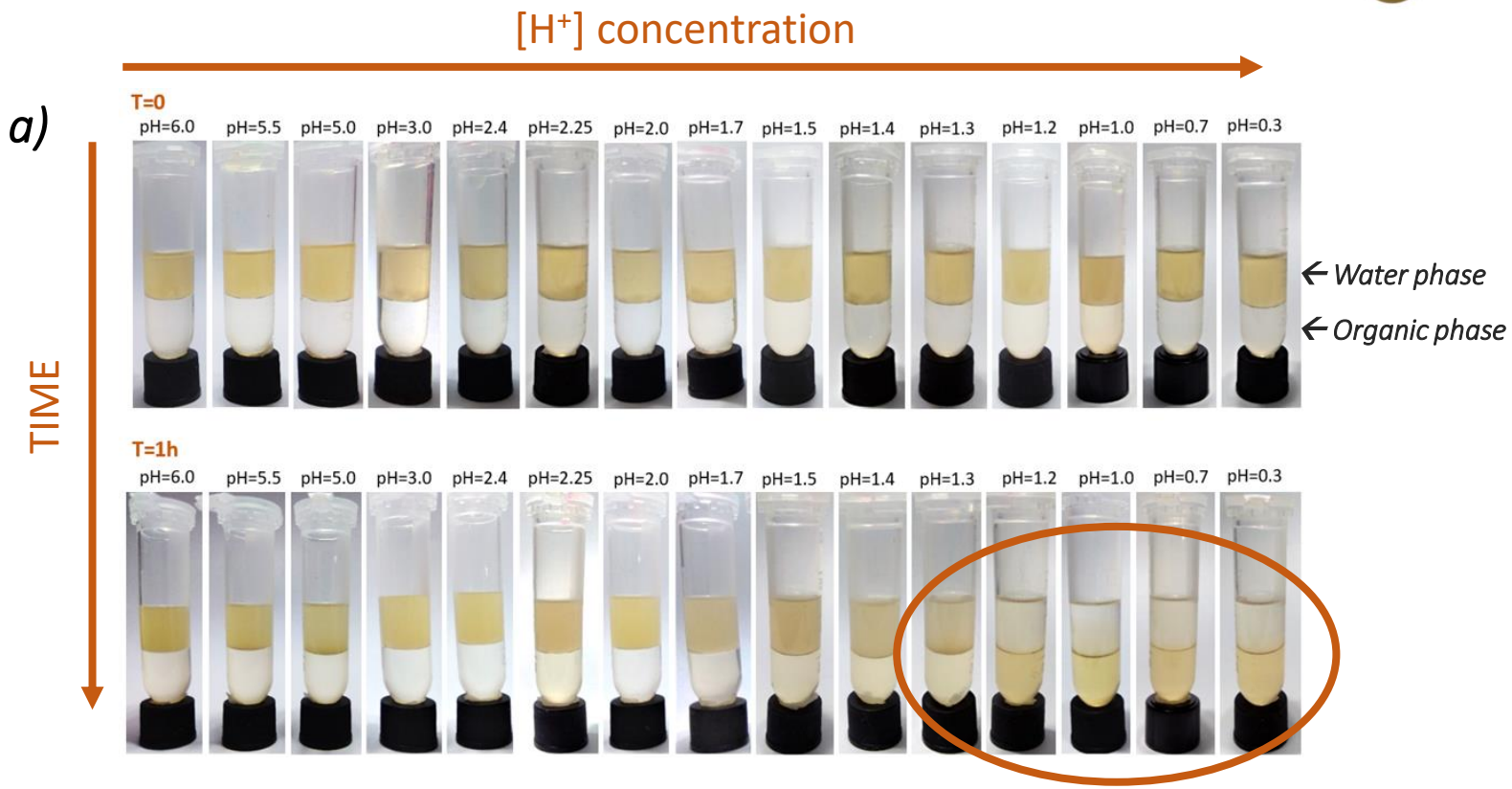
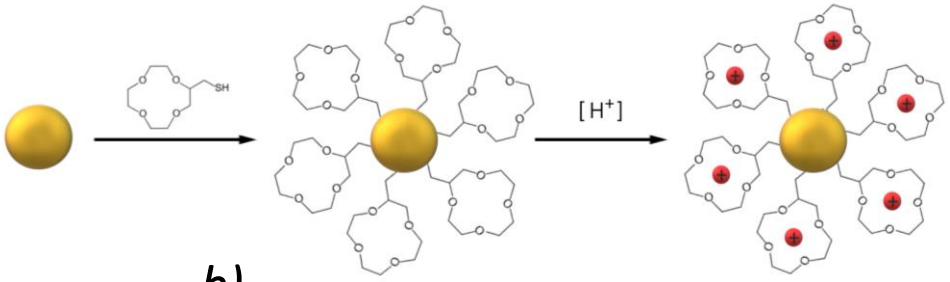
GNCs hydrophobicity





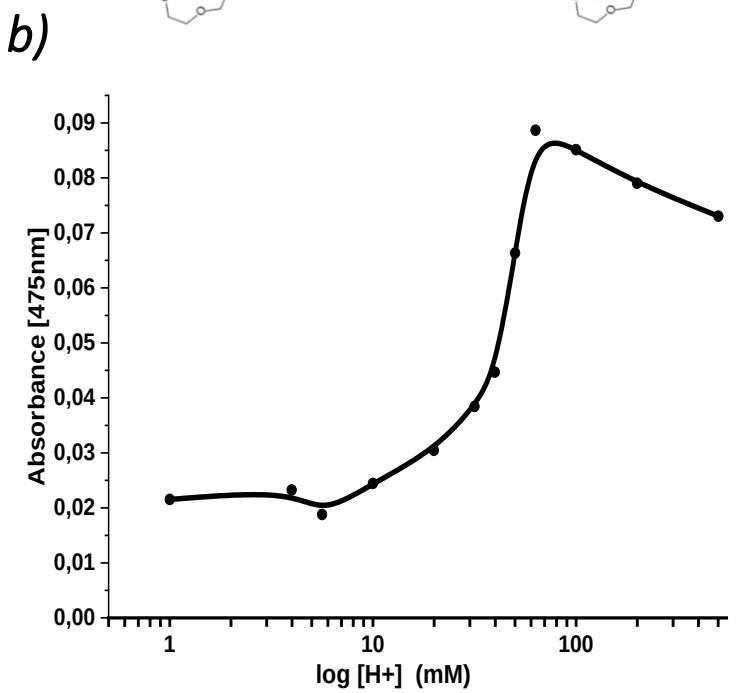


Fig. 2. The photos of] Au/12-crown-4 ether NCs phase transfer from water to chloroform at the broad range of pH. (b) relations of absorbance of nanoclusters suspended in water phase after 1h contact with organic phase at various pH ranges.

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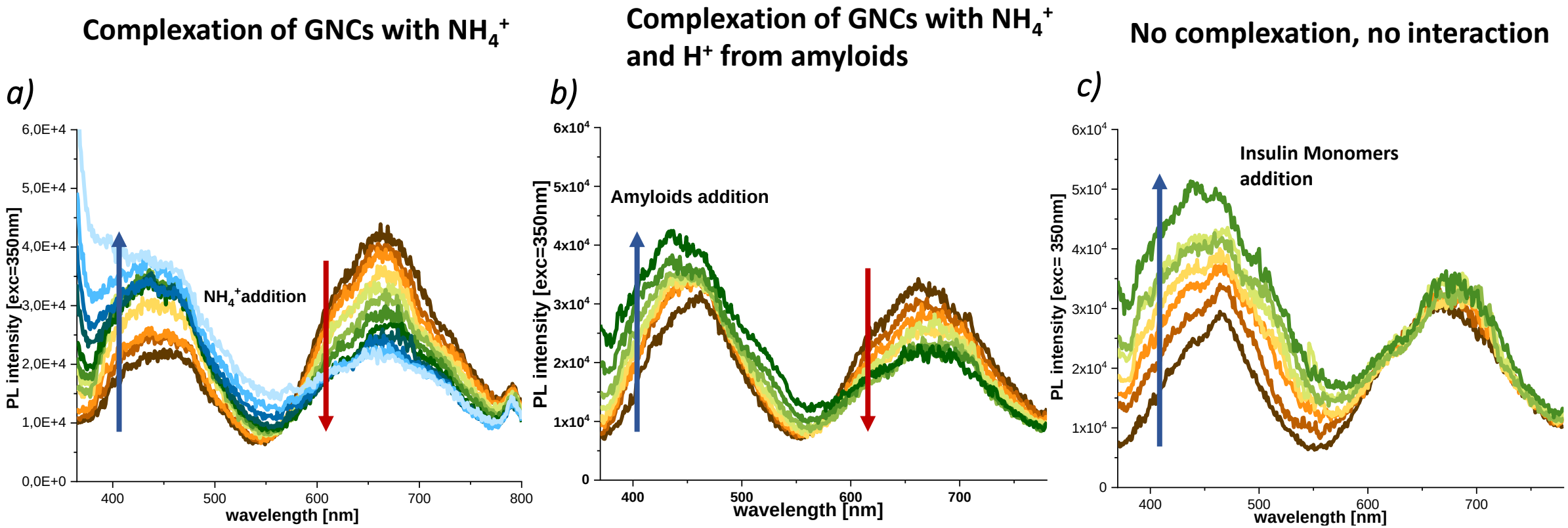

Figure 3. Gold nanoclusters fluorescence spectra upon complexation a) with NH_4^+ b) H^+ and NH_4^+ ions from amyloids in neutral conditions (a). Fluorescence band attenuation at ~670nm is associated with self organization of GNs along fibrils. Lack of changes in fluorescence band ~670nm upon addition of INS monomers proves high selectivity of the detection

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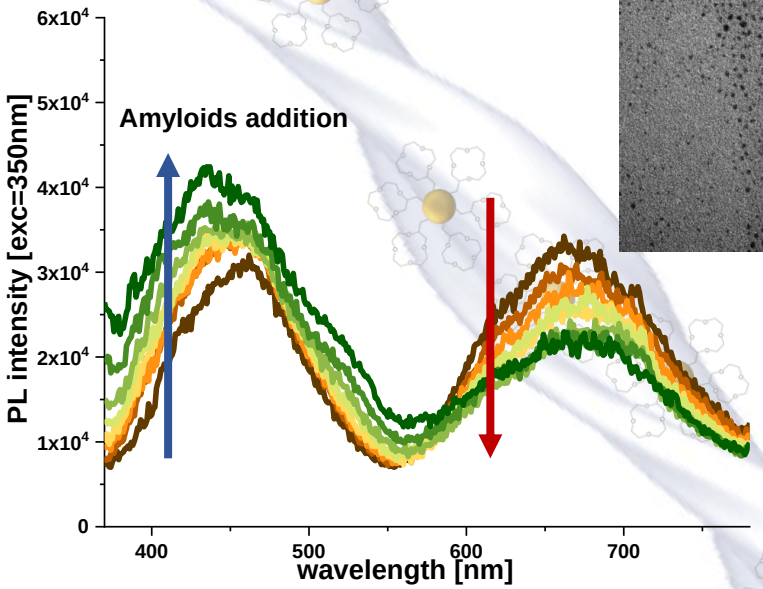
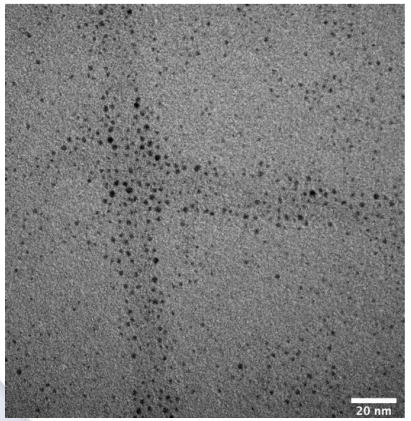
Conclusion

- Successful design and synthesis of the new material – ultra-small, strongly fluorescencent gold nanoclusters
- Self-assembly of GNCs along amyloids fibrils imaged with TEM microscopy and confirmed spectroscopically via luminescence
- Proved high-selectivity of the detection of proteins aggregates among native forms of proteins





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Project team leader: dr hab. inż. Joanna Olesiak-Bańska, prof. PWr

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