www.hysens.eu

THE HYSENS PROJECT

HYBRID MOLECULE NANOCRYSTAL ASSEMBLIES FOR PHOTONIC AND ELECTRONIC SENSING APPLICATIONS

The main objective of the HYSENS project is to exploit organic functional molecules and inorganic nanocrystals as building blocks for the assembly of novel hybrid smart materials for detection of Group I, II, transition metal cations and anions in water and artificial serum matrices. A series of hybrid materials were synthesised and the potential for ion sensing with low sensitivity and high selectivity in water has been demonstrated. The project has met most of the targeted limits of detection, thus showing the potential of these materials to provide alternatives to currently used cumbersome analytical tools. Furthermore, the integration of the sensor units into model structures and subsequent demonstration of optical and electrical read outs emphasises the exploitation potential of the HYSENS platform and its potential benefit for EU citizens and industry.

PROJECT HIGHLIGHTS

1. **A series of building blocks constituted by inorganic nanocrystals and organic ligands were designed and successfully prepared. Organic ligands were engineered to bear anchoring groups for inorganic nanocrystals and functional groups for the selective complexation of group I and II cations, heavy cations and anions. The inorganic nanocrystals were engineered to transduce ion sensing promoted by the organic ligand moiety into an optical or electrical read-out.**
2. **Four classes of hybrid structures constituted by synthesised building blocks were assembled and characterised.**
3. **Luminescent sensors were developed, showing high affinity for heavy metal ions such as Pb^{2+} and Cu^{2+}, with limits of detection (LODs) below 10 and 1 µg/L, respectively. Sensors based on the modulation of scattering intensity of inorganic nanoparticles were also developed with demonstrated sensitivity for Hg^{2+} < 200 µg/L.**
4. **Ion-selective organic electrochemical transistors (IS-OECTs) were fabricated with electrochemical detection of K^+ in the µM range demonstrated.**
5. **Si nanowire FETs were fabricated and chemically modified with hybrid molecules. Successful electrical detection of Na^+ with 100 µg/L LOD was demonstrated. Multiplex cation/anion detection (Na^+/F^-) was achieved with Si nanowire FETs integrated into microfluidic flow cells .**
6. **Fabrication of optical sensor based on a miniaturized data matrix code En-TAG™ with built in optical reader for fluorescence and scattering read out. Fluorescence detection of Na^+ and initial scattering detection of Cu^{++} with µg/L limits of detection were achieved.**
7. **Low leakage flow cells were fabricated and optimised for fluorescence and scattering read out. Hg(II) and F^- detection at mg/L level was achieved with incorporated hybrid molecules.**

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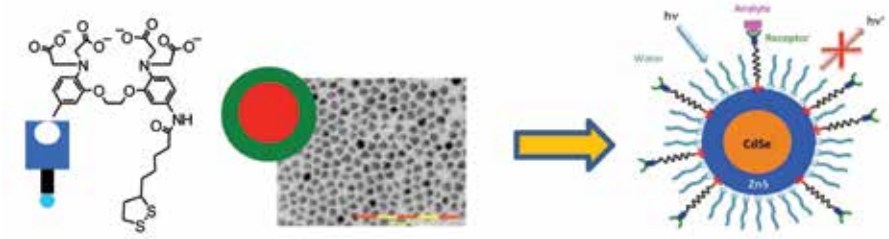
SEVENTH FRAMEWORK PROGRAMME

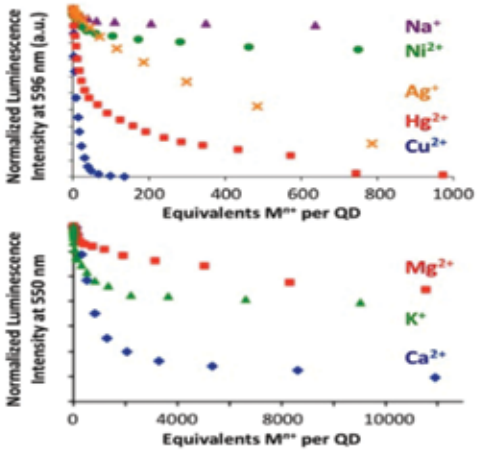
CONCEPT



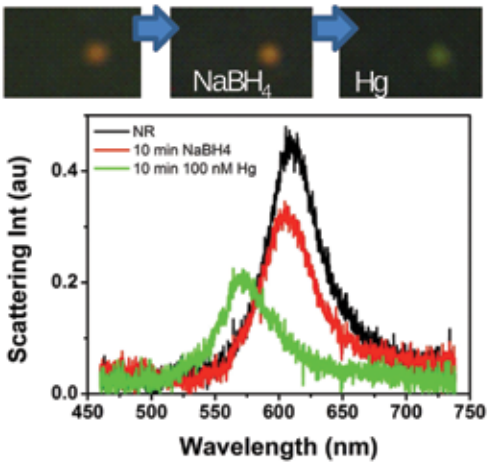
MOLECULES | NANOCRYSTALS | ION DETECTION

IMPLEMENTATION

LUMINESCENT DETECTION

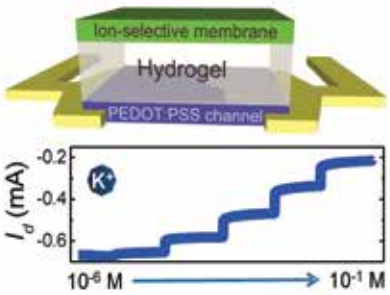


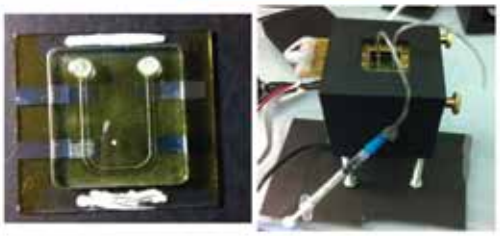
SCATTERING DETECTION



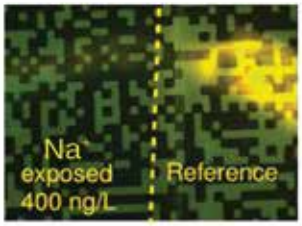
INDUSTRIAL VALIDATION

ELECTROCHEMICAL DETECTION





OPTICAL DETECTION ON TAGS



ELECTRICAL DETECTION