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pH sensors

IPCB – CNR

FINAL DISSEMINATION EVENT

BARCELONA, 26 – JANUARY - 2017

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The Institute

Institute for Polymers, Composites and Biomaterials (IPCB-CNR) – Pozzuoli, Italy

- The largest CNR institute devoted to research on polymer based materials (≈100 researchers and technicians)
- Many research fields (polymer chemistry, green chemistry, sustainability, nanomaterials, aerospace, biomedics, sensors)

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 614155.

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The research group

Mix of chemists and engineers

- Expertise in composites and nanocomposites fabrication and analysis
- Experience with environmental-focused projects

Role on CS: **Development of pH/pCO2 nanocomposite sensors**

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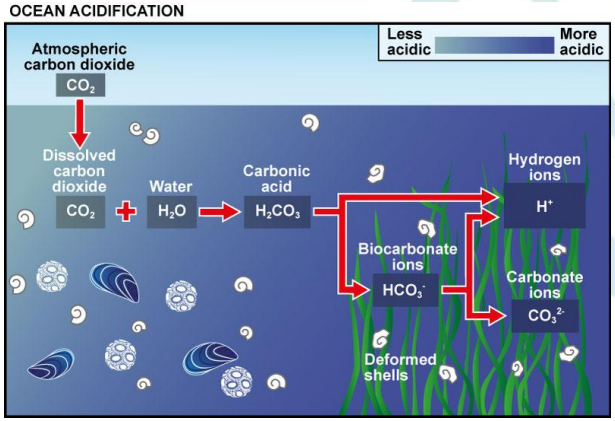
State of the art

Seawater pH is relevant for living organism and for chemical reactions/equilibria

- Related to climate changes (ocean acidification)
- pH sensing is also routine in lab/industrial applications
- Common pH sensors based on glass electrodes
- Many alternatives (ISFET devices, spectrophotometric systems)



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Objectives

New cost effective sensors requirements: small dimensions, easy production and maintenance, robust, reliable and accurate

(Conductive) polymers can do the job!

- Redox behaviour pH dependent
- Resilient to mechanical and thermal shock
- Easy to process
- Allow electrical measurement (simple design)
- Nanoparticles can increase surface area and tune properties

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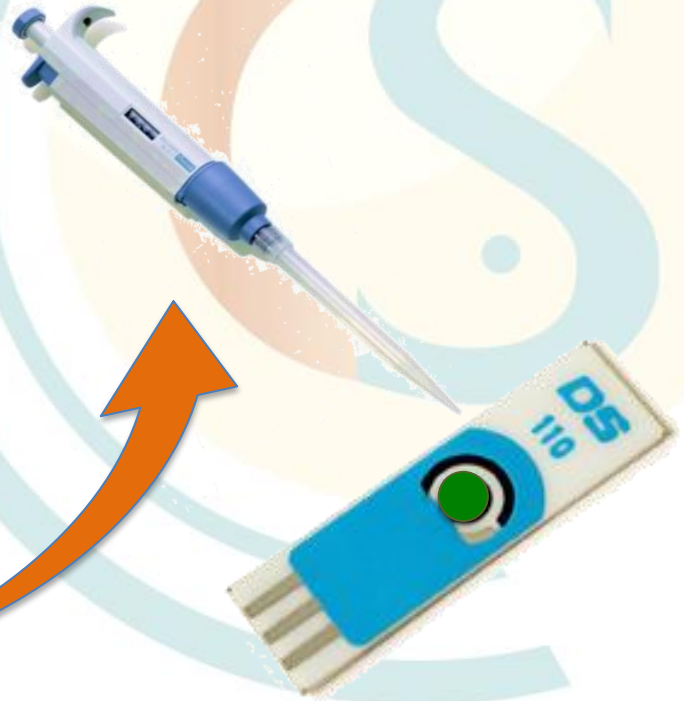
Technical description

Alternative approach: voltammetry

- Commercial materials: polyaniline, multi-walled carbon nanotubes, carbon electrodes
- Suspension mixing
- Drop casting electrode modification

PANI 1% in NMP

MWCNT in NMP



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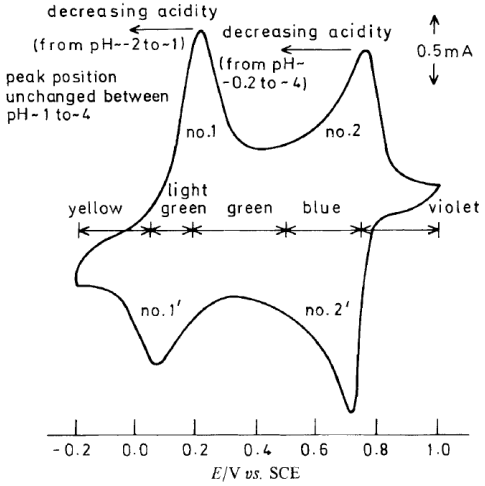
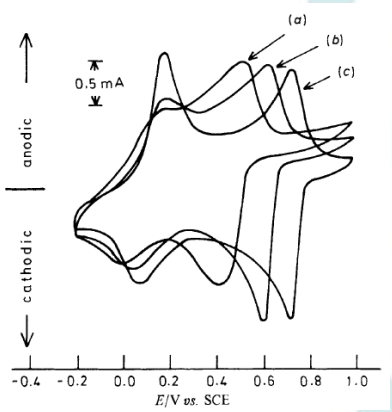
Technical description

Polyaniline oxidation states are governed by a protonation/deprotonation process





- Well characterized in acidic solutions
- Nanotubes affect PANI behaviour at neutral – alkaline pH

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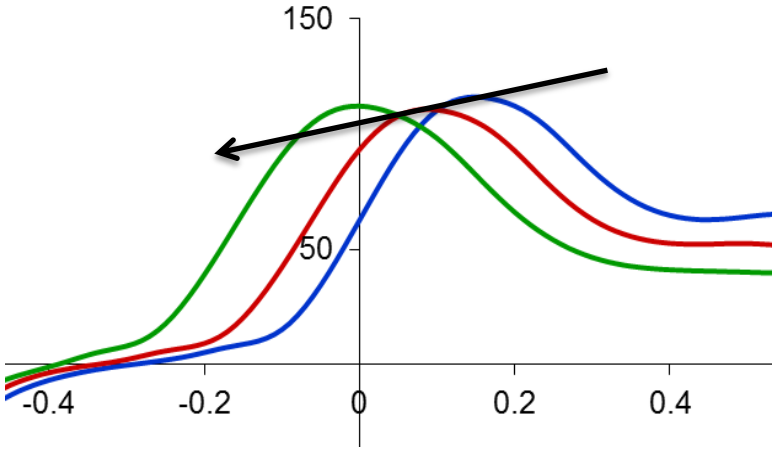
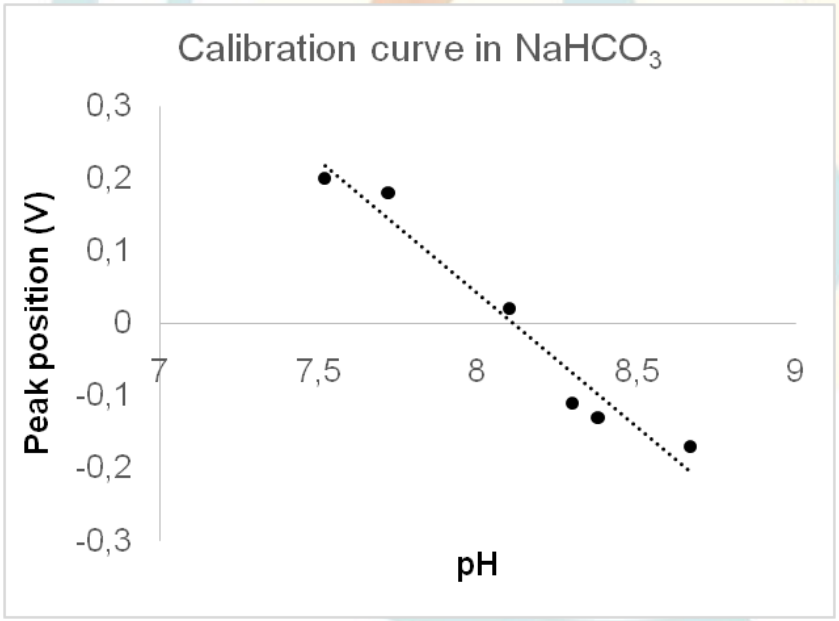
Technical description

CV peaks potential depends on pH

- Calibration in seawater pH range
- Validation in real seawater samples





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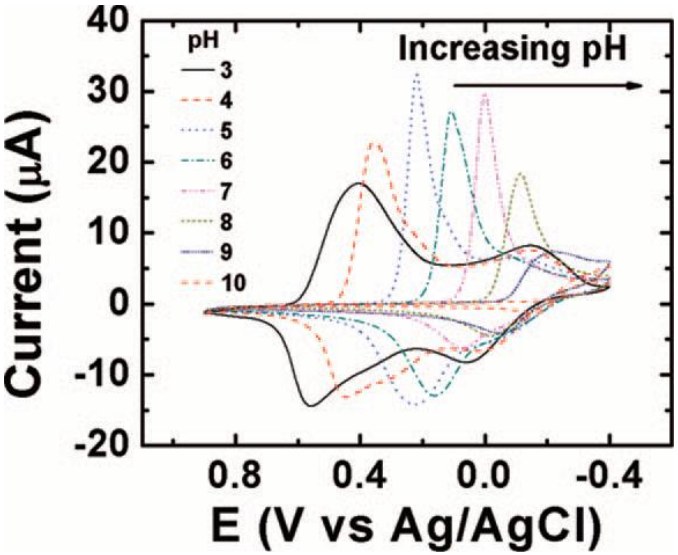
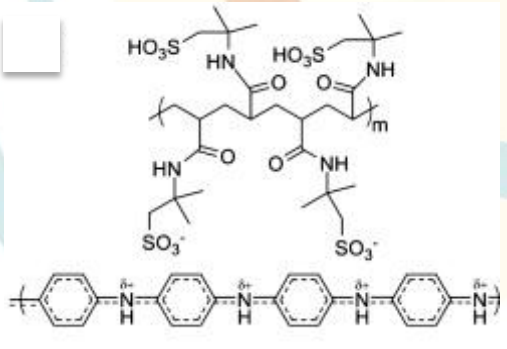
Technical description

CV peaks potential depends on pH

- Similar behaviour was observed in PANI/polymeric acid (PAAMPSA) complexes
- Clarification of MWCNTs role





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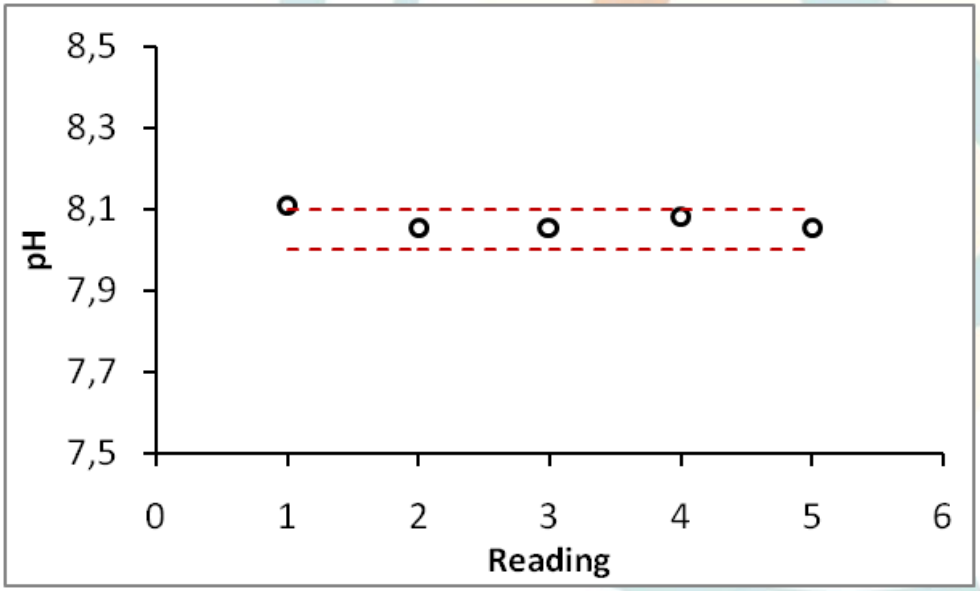
Technical description

CV peaks potential depends on pH

- Calibration in seawater pH range
- Validation in real seawater samples
- Repeatability is fairly good
- Sensitivity is low



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Results summary

- A new polymer based sensor for pH was proposed
- Very cheap, small, robust, ready to produce
- Sensitivity is low and must be improved
- Hand-made deposition of drops and poor filming ability of PANI decrease the reproducibility of electrodes
- TRL 3/4

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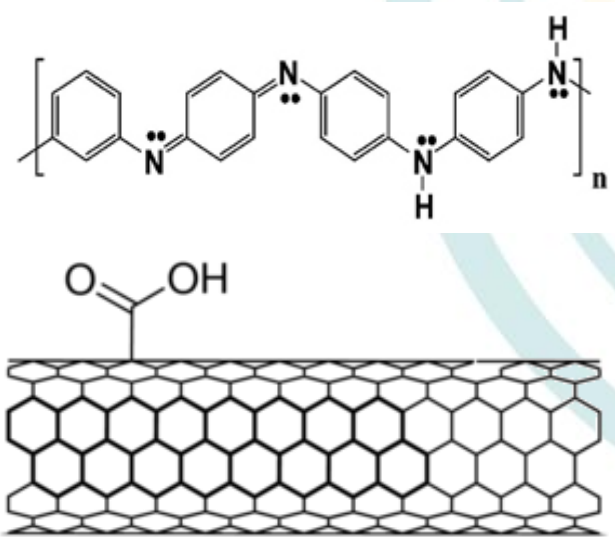
Next steps

- Deeper investigation of PANI-CNTs interaction mechanism and it's consequences (conductivity)
- Test the material in other measurement setup (potentiometric)



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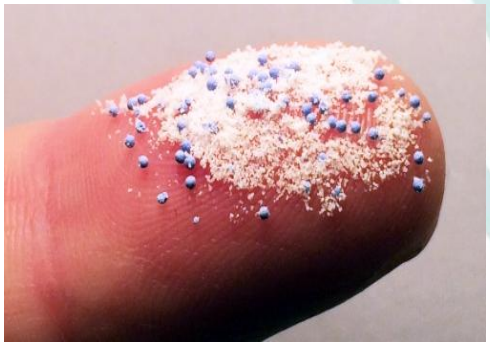
Concerning marine environment…

International Conference on Microplastic Pollution in the Mediterranean Sea

Capri, Italy, 26 – 29 September 2017

www.microplasticpollution.org (under construction)



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Thank you for your Attention

maurizio.avella@ipcb.cnr.it

gennaro.gentile@ipcb.cnr.it

roberto.avolio@ipcb.cnr.it

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