SYNTHESIS OF IRIDIUM AND PALLADIUM NANOCLUSTERS FOR BIOMEDICAL APPLICATIONS

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Metal nanoclusters (MNCs) have become one of the most promising nanomaterials in the analytical chemistry area due to their optoelectronic properties and the possibility of their bioconjugation to different types of biomolecules (e.g. antibodies, Ab). Thus, **MNCs can be used as labels for the detection of specific biomolecules in biological samples** (e.g. fluids, tissues or cells). MNCs have diameters smaller than 3 nm, so they can be employed to label Ab without disrupting their recognition capabilities. Another advantage of MNCs compared to other labels is the possibility of performing **multimodal detection** by fluorescence, electrochemistry and mass spectrometry (MS). Such multimodal detection will allow both the characterization of the synthesized MNCs as well as the validation of the analytical methodologies developed for the determination of biomolecules. In this study, the synthesis of **new IrNCs and PdNCs** is presented.

Objective

Development of new MNCs (PdNCs & IrNCs) for their further application as labels for the determination of proteins in biological samples

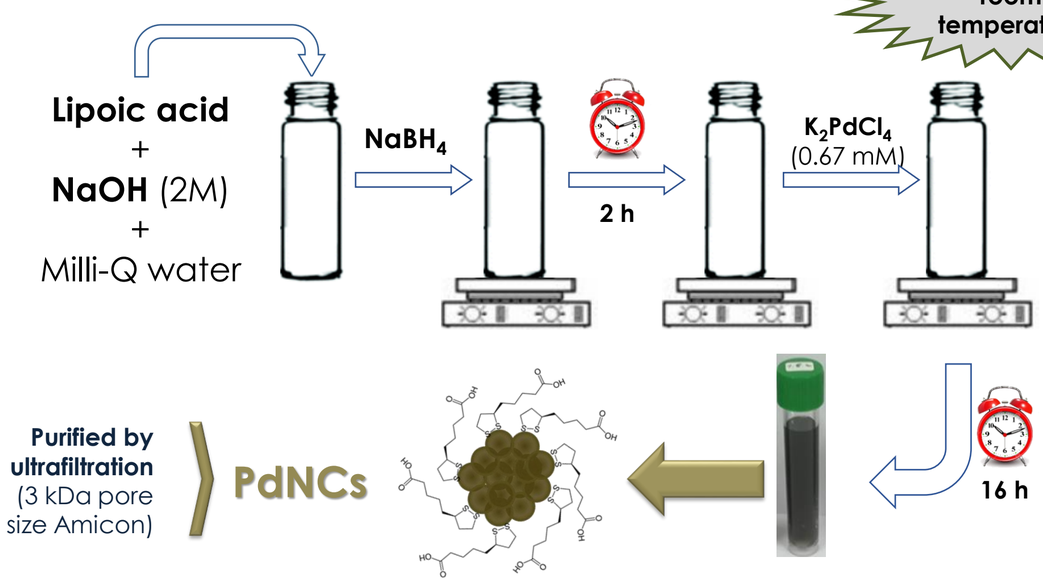
PdNCs
IrNCs

- ✔ Stable
- ✔ Fluorescent
- ✔ Water-soluble
- ✔ Bioconjugation to Ab

EXPERIMENTAL STEPS

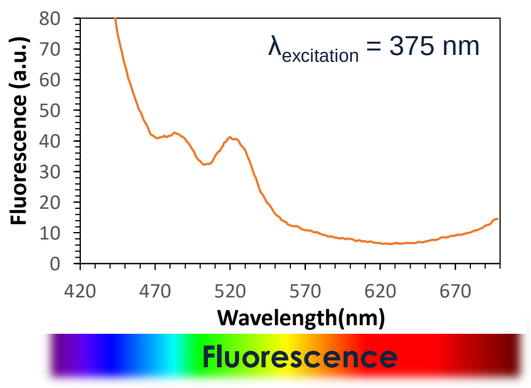
Synthesis and Characterization of PdNCs

Synthesis

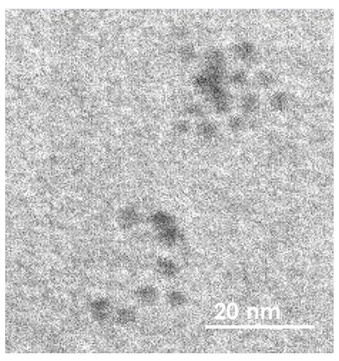


Characterization

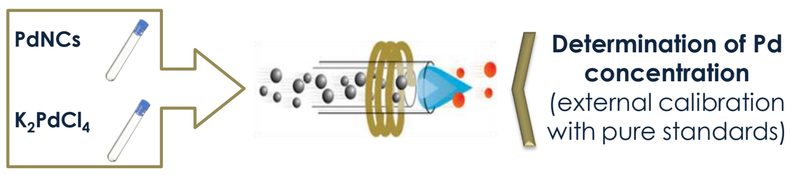
✓ **DLS measurements**
Hydrodinamic Ø: 29 ± 4 nm
Polydispersity index (PDI)= 0.252



✓ **TEM measurements**
Ø: 3.49 ± 0.25 nm (n= 62)



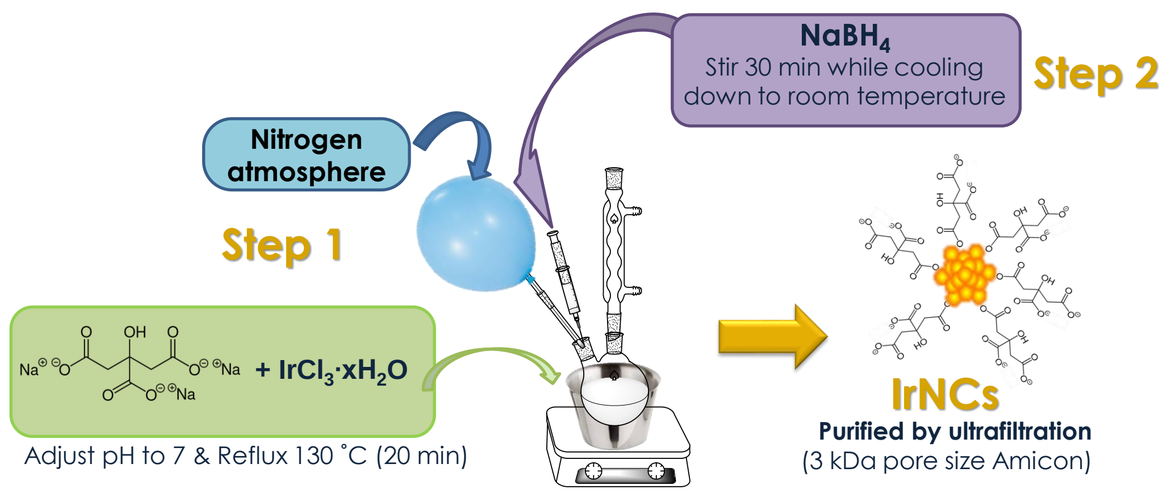
✓ **ICP-MS analysis**



❖ Synthesis yield: 78%
(Calculated by a mass balance between the [Pd] in the precursor and in the purified synthesis)

Synthesis and Characterization of IrNCs

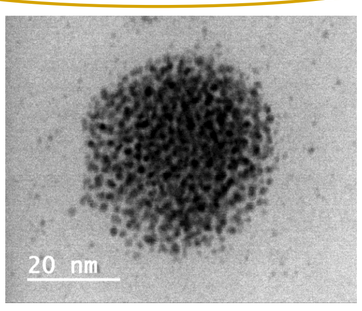
Synthesis

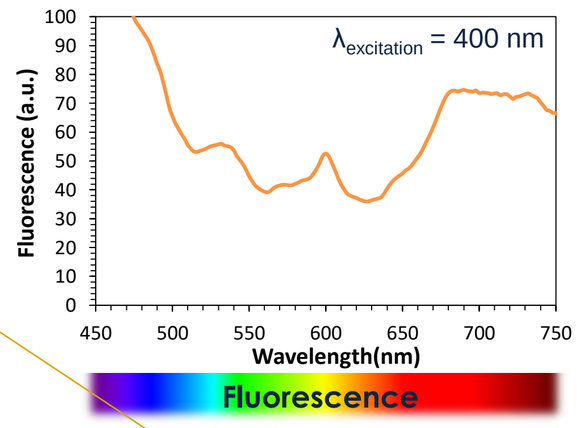


Characterization

✓ **DLS measurements**
Hydrodinamic Ø: 39 ±11 nm
Polydispersity index (PDI)= 0.288

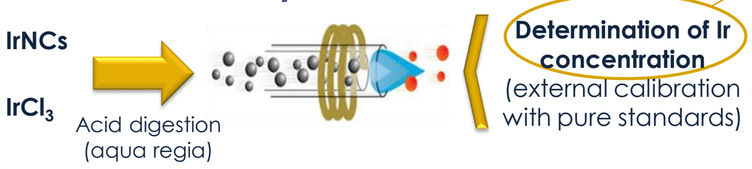
✓ **HR-TEM measurements**
Ø: 1.79 ± 0.04 nm (n= 144)
SAED → fcc crystal lattice





214 atoms Ir/NC

✓ **ICP-MS analysis**



❖ Synthesis yield: 53%
(Calculated by a mass balance between the [Ir] in the precursor and in the purified synthesis)

PROGRESS AND ACHIEVEMENTS

- **The synthesis of PdNCs and IrNCs with fluorescent properties has been successfully achieved**. In both cases, different parameters have been optimized in order to obtain small and monodisperse MNCs: the molar ratio between metal precursor:ligand:reducing agent, the type of ligand (lipoic acid and citrate), the reaction time, and the temperature, among others.
- **MNCs have been characterized** by absorbance, fluorescence, DLS, ICP-MS, TEM and HR-TEM measurements.
- PdNCs were found to have an average diameter of 3.49 nm. In the case of IrNCs, a smaller diameter was obtained (1.79 nm) and it was possible to calculate the number of Ir atoms per NC: 214.

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