# DIAGNOSTIC PROBES TO DETECT CELLS AND TISSUES AFFECTED WITH A PATHOLOGICAL OR METABOLIC CONDITION BY MEANS OF INFRARED SPECTROSCOPY

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# Invention

The present invention provides an ***in vitro*** **and** ***ex vivo*** **method using novel diagnostic probes** with a specific spectrum detected by **infrared (IR) spectroscopy**. The novel probes were appropriately designed to exploit certain peculiarities of pathological tissues, such as **increased glucose uptake** or **overexpression of certain membrane components**. The compounds were found to be highly stable and easy to handle, compared with radiodiagnostic probes commonly used in conventional techniques.

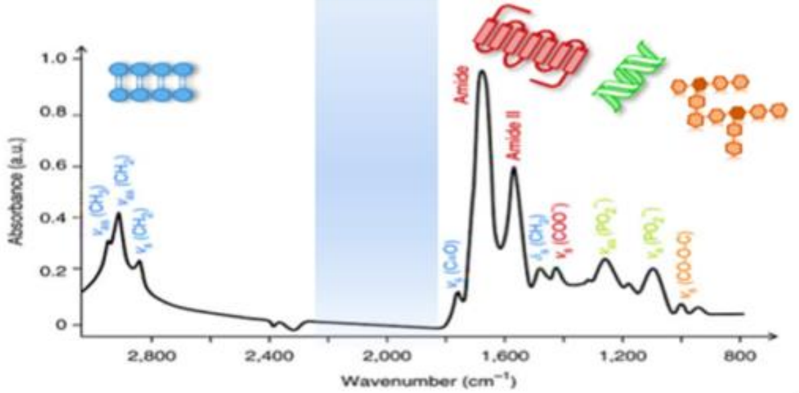
The diagnosis and characterization of cancer pathologies are mainly focused on the use of radioactive markers, such as fluorodeoxyglucose (FDG) in PET. FDG, a radioactive analog of glucose, takes advantage of the peculiar metabolism of most tumors, which rapidly incorporate large amounts of glucose so that they are visible on PET. This technique, although widely used for *in vivo* imaging, is less suitable for routine applications, such as s**olid or liquid biopsies**, due to the short half-life (~2 hours) of the fluorine radionuclide ($^{18}F$).

The invention aims to the development and innovative use of molecular probes containing 1) a **portion recognized by specific factors overexpressed by cancer cells**, such as GLUTs proteins, and 2) a **"probe" that absorbs in the IR transparency window of cells** (1800-2200 $cm^{-1}$), consisting of a tricarbonyl cyclopentadienyl-rhenium(I) complex. The chemical entities are stable in aqueous biological media and exhibit **intense absorption bands in the 1900-2100 $cm^{-1}$ zone**, making them suitable for IR imaging of cancer cells and tissues.

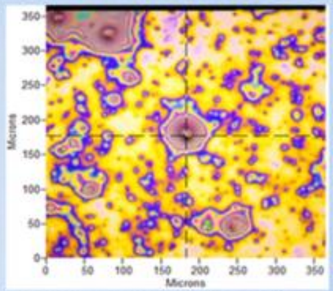
Drawings
& pictures

## INFRARED SPECTROSCOPY

CHARACTERISTIC "MARKER BANDS" FOR DIAGNOSTIC PURPOSES



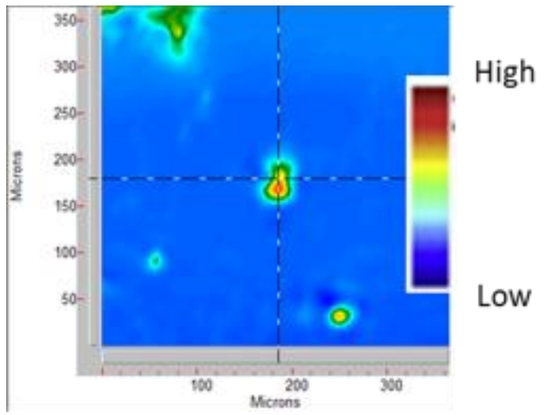

IR spectra of cells in the region 3000-800 cm$^{-1}$




Cells treated with the probe

## INNOVATIVE PROBES

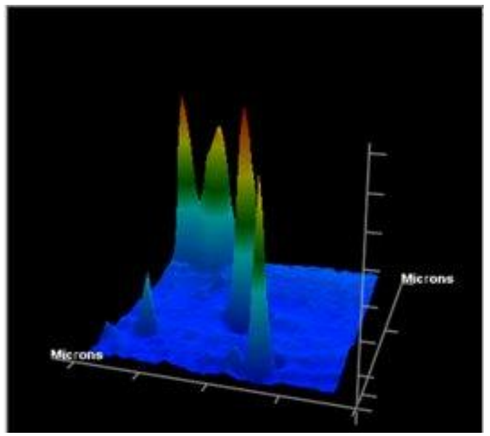
*used to analyze the spectral changes and differences of the absorption of tumoral cells due to their altered metabolism*




High

Low

2100 cm$^{-1}$ (probe)



# Industrial applications

The invention represents an innovative approach for the medical field, as it would lead improvements in the diagnosis of very serious diseases, such as cancer.

The main fields of application are:

- *in vitro* and *ex vivo* imaging;
- early diagnosis of cancer diseases;
- rapid identification of cancer cells in samples derived from solid or liquid biopsies;
- FTIR imaging to diagnose molecular differences between normal and diseased tissues.

## Possible developments

A comparison with similar technologies is not feasible to evaluate because there are no commercially available **diagnostic probes that use infrared (IR) spectroscopy** to identify cells in pathological conditions, particularly cancer cells.

The innovative compounds have been developed by simple synthetic steps and demonstrated high stability in aqueous solutions. The **absence of specific precautions** to be taken in production steps and post-production handling, which are essential for the use of radiopharmaceuticals instead, allows their easy applicability and suitability for long-range transport.
Their use and the development of similar products can drastically reduce the use of radiopharmaceuticals and consequently the risks associated with handling radioactive substances.

A pool of chemical entities has been developed to test their characteristics, and structural analogues are planned to be designed to improve their properties. The first prototypes have already been tested on pancreatic cancer cells.

The inventors are interested in future collaborations and licensing opportunities to increase the technological maturity of the invention and be able to offer innovative products for IR diagnosis of cancer diseases.

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