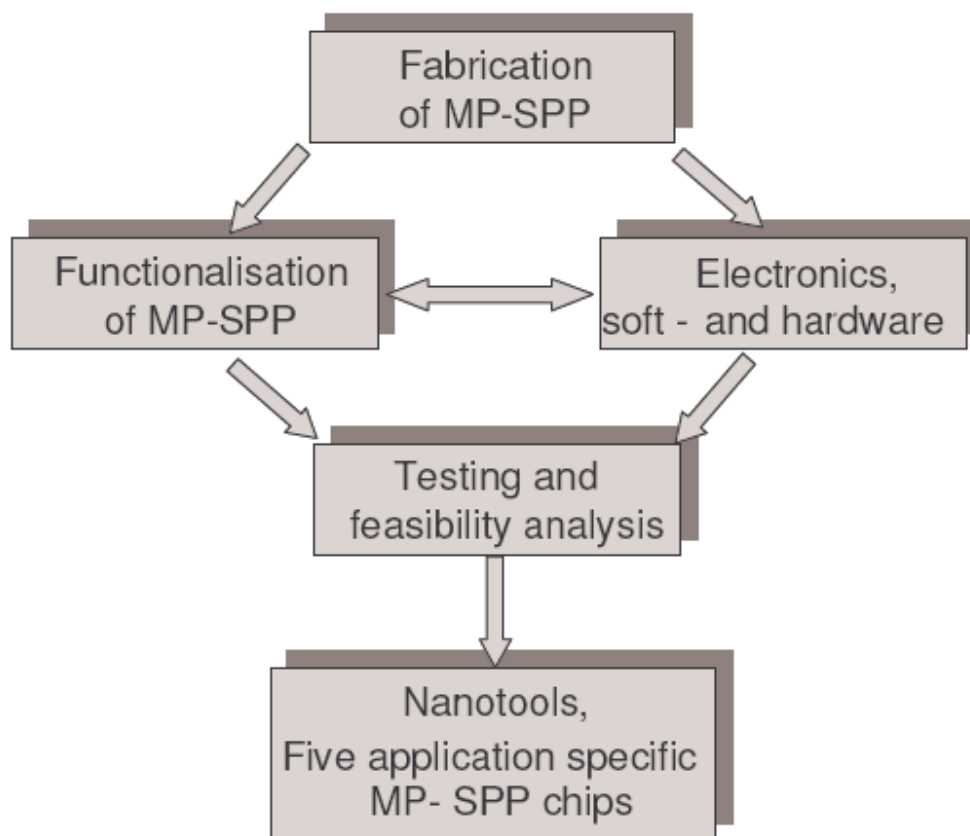




## Public document about the first 18 months of activity of the project TASNANO



During the first 18 months of the project several results were achieved. They are described briefly below. The specific results are object of scientific publications under development.

### **WP1. Fabrication of scanning proximal probes**

Review and assessment of various innovative readout principles and integration technologies.

Finite Element Analysis for best SPP sensitivity of the piezoresistor.

Finite Element Analysis for best SPP actuation efficiency.

First optimised design SPP sensors with integrated readout and metal pad.

First sensitive SPP sensors with integrated readout and metal pad.

Stress Concentration Region in silicon based cantilevers to enhance piezoresistive displacement, force, and torque sensitivities

Review and assessment of innovative cantilever actuation principles & integration technologies.  
Review and assessment of various bimorph actuators principles.  
Single Cantilevers chips with piezoresistive readout and chemical/bio pad.  
Assembly of Cantilever Array Modules SPM sensors equipped with Ultra Sharp.  
High Aspect Ratio Conductive Tip Simple Chip Holder for operation in liquid, vacuum and air.  
Chip Holder for operation in liquid and air.

## **WP2. Analog and digital data path electronics-hardware and software**

Review and assessment of various innovative readout electronics and cantilever deflection control methods.  
Development of measurement electronics for Tasnano single cantilever (with manual compensation of sensor offset, options for MOS transistor control and polymer sensors; DC version of input stage).  
Static experiments with single Tasnano cantilevers in Contact Mode of SPM calibration of sensor sensitivity and resolution, investigation of cantilever deflection control.  
Development of AC input electronics for single Tasnano cantilever (including polymer and MOS sensor version; Amplitude detection).  
Resonance experiments with single cantilevers in Tapping Mode of SPM calibration of resonance cantilever properties.  
Review and assessment of principles of microcontroller based circuitry for sensor offset voltage compensation (including version for MOS and polymer cantilevers).  
Testing and optimization of noise properties and DC stability of input electronics combined with microcontroller based compensation circuitry.  
Review and assessment of low noise and selective AC amplifier designs for acquisition of signals from input stage sensor electronics.  
Review and assessment of fast phase signal comparators for detection of shift lag between sensor signal and oscillation signal.  
Testing of control behaviour of thermal deflection actuation.  
Development of software procedure enabling the calibration of sensor force constants based on resonance frequency measurements and force/displacement sensor sensitivity.  
Review and assessment of resolution and sensitivity possibilities of piezoresistive cantilevers (including MOS and polymer based sensors with/without metal pad)- estimation of correlation between measurement bandwidth and detection resolution.  
Development of software for static cantilever deflection, excitation of cantilever resonance oscillation  
Review and assessment of various control electronics for nanopatterning.  
Development of high voltage and high speed voltage and current sources for control of field emission current flowing from the cantilever ultra sharp conductive tips.  
Design of temperature stabilized low volume chamber including Tasnano sensor exchange port.  
Design and development of microchamber temperature controller enabling temperature adjustment with resolution of 0,1K in the range from 300K up to 350K.

## **WP3. Functionalisation**

Hydrophobic polymers for CH air/water pollutant detections.  
Process for patterning different monolayers that are needed for nanoelectrochemistry studies.  
Report on the application of focused particle beams for the processing of SPPs.

Report on bio-functionalised cantilever sensitivity to specific analytes.  
Identification of protocols for successful molecular immobilisation on individually cantilevers or tips.  
Report on properties of polymeric materials for CH absorption.  
Tip functionalisation with proteins.

#### **WP4. Testing and feasibility analysis**

High sensitivity single cantilever.  
Cantilever modules.  
Probe interface electronics.  
Probe with electronic functionality.