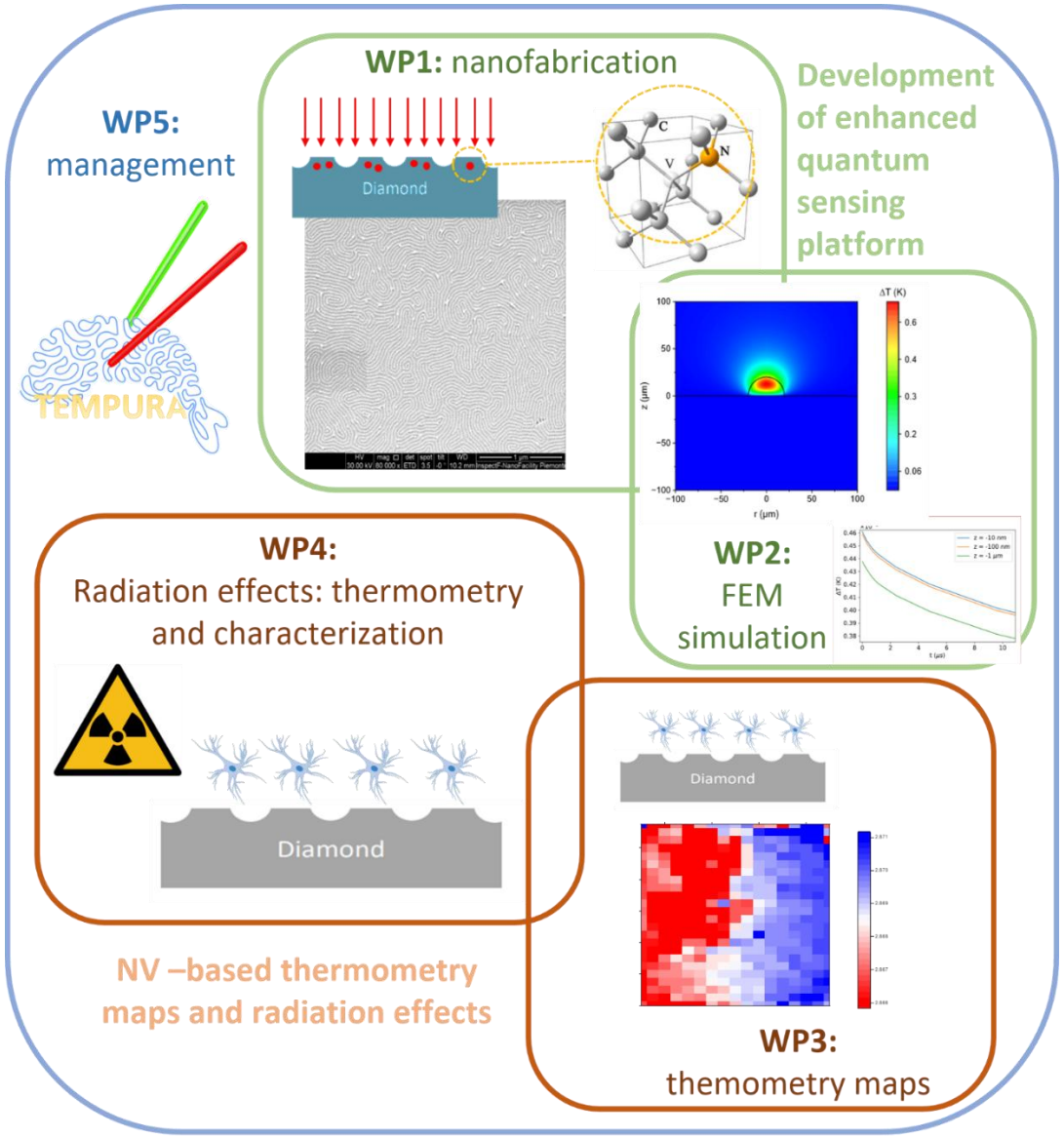
TEMPURA

Development of a diamond-based TEMPerature qUantum sensor to evaluate the effect of RAdiation in brain cells



Objective:

project goal is

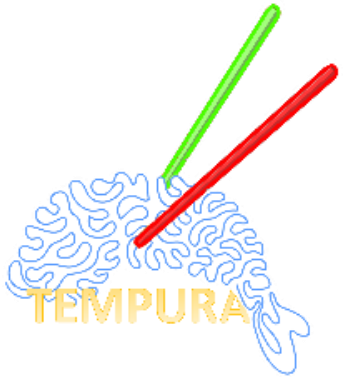
- ✔ to **develop** a novel **temperature quantum sensors** based on **artificial diamond**
- ✔ to assess if the **ionizing radiation** has **effects** on the **cells functioning** that can be **detected by temperature variations**.

WP1 (INFN-TO Leader): Development and fabrication of diamond sensors optimized for spatially resolved (quantum) thermometry.

WP2 (INFN-TO Leader): Theoretical Calculations of the thermal properties of nanopatterned diamond substrates

WP3 (INFN-BO Leader): Spatially resolved thermometry on cells in vitro

WP4 (INFN-BO Leader): Evaluate the effect of ionizing radiation on cells in vitro: quantum thermometry, fluorescence microscopy, cytofluorimetric essay



TEMPURA

Development of a diamond-based TEMPerature qUantum sensor to evaluate the effect of RAdiation in brain cells

INFN-TO (local coordinator: F. Picollo, total FTE 3.3)

core expertise: *Ion beam implantation; material processing and characterization*

facilities: *Solid State Physics laboratories*

INFN-BO (national coordinator: A. Candini, total FTE 2.6)

core expertise: *Quantum sensing, X-ray irradiation, neuroscience*

facilities: *ODMR set-up, biological laboratories, X-ray microfocus source*

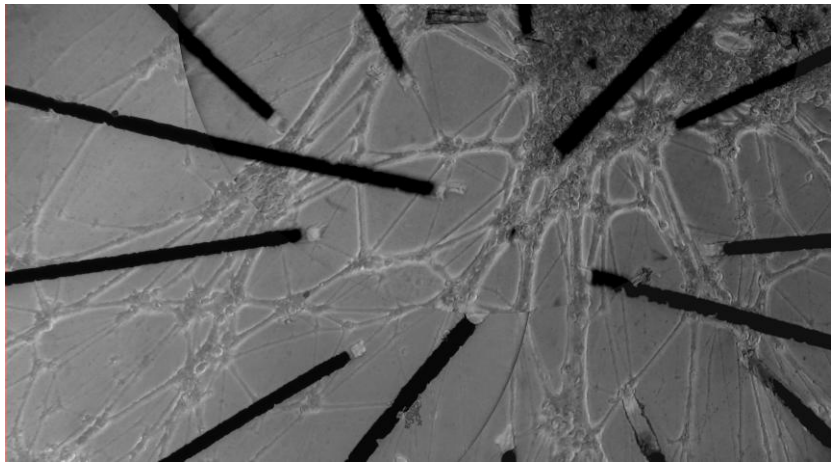
INFN TO - Members	
Amine	50%
Alessio	60%
Britel	50%
Olivero	30%
Picollo	40%
Sturari	40%
Truccati	40%
Vittone	20%

Project duration: 3 years (2025 – 2027)

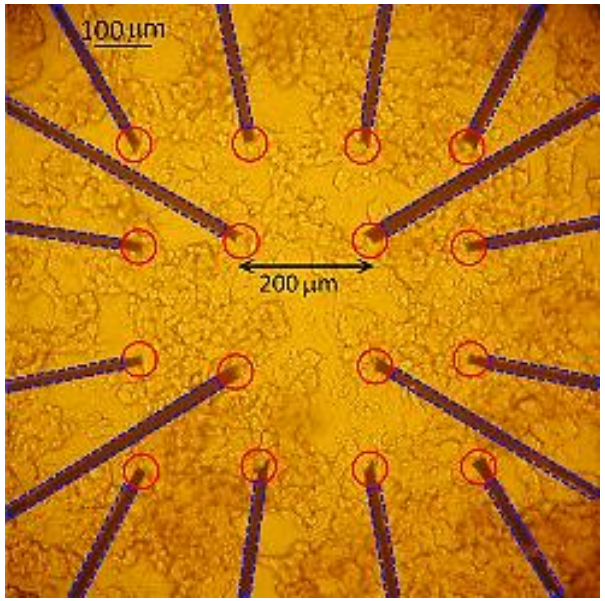
Total budget: 45 k€/year

In vitro experiments on diamond substrate

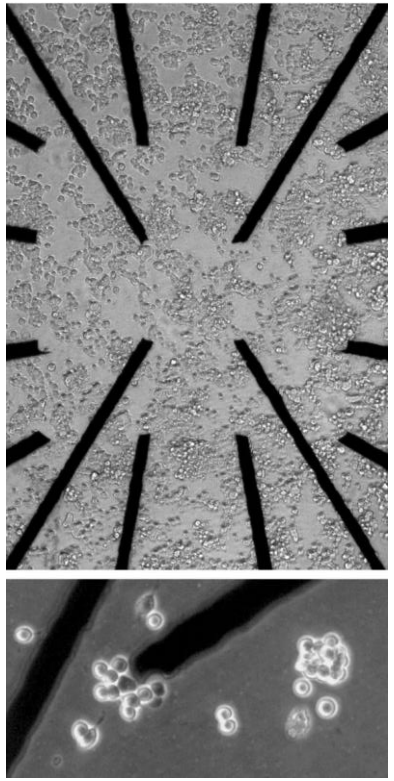
Large experience on *in vitro* application of diamond →
Possibility of growing for long period (several weeks) cells directly over diamond surface



Substantia Nigra Neurons
- Mid-brain dopaminergic neurons
- Primary culture



Chromaffin cell
- Neuroendocrinal cells



PC12 cell line
- dopaminergic cell line

Activity performed in CSN5 projects →
- **DINAMO (2013 - 2015)**
- **DIACELL (2016 – 2019)**
- **RESOLVE (2020 – 2023)**

Self-Assembly of Block copolymers PS-b-PMMA on Diamond surface

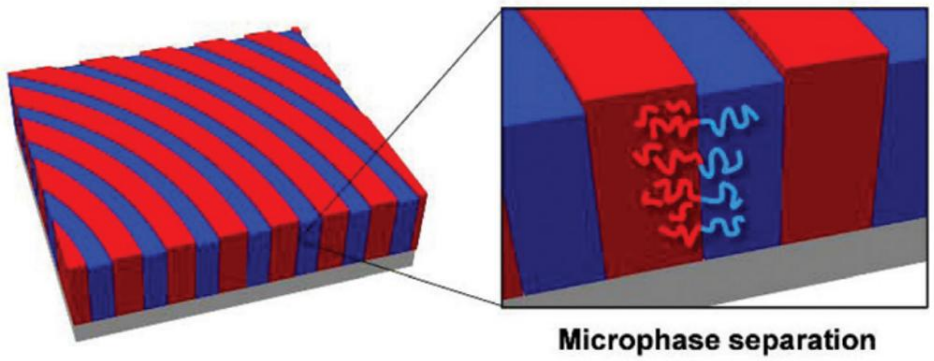
Thermal Annealing

↓

Microphase separation (Self-Assembly)

↓

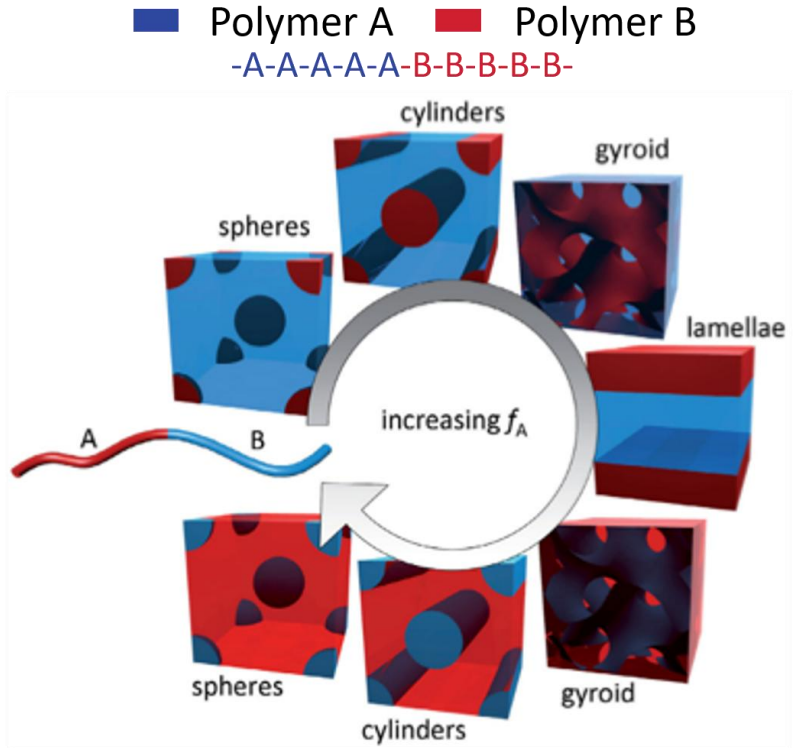
Periodic arrangement at the nanoscale

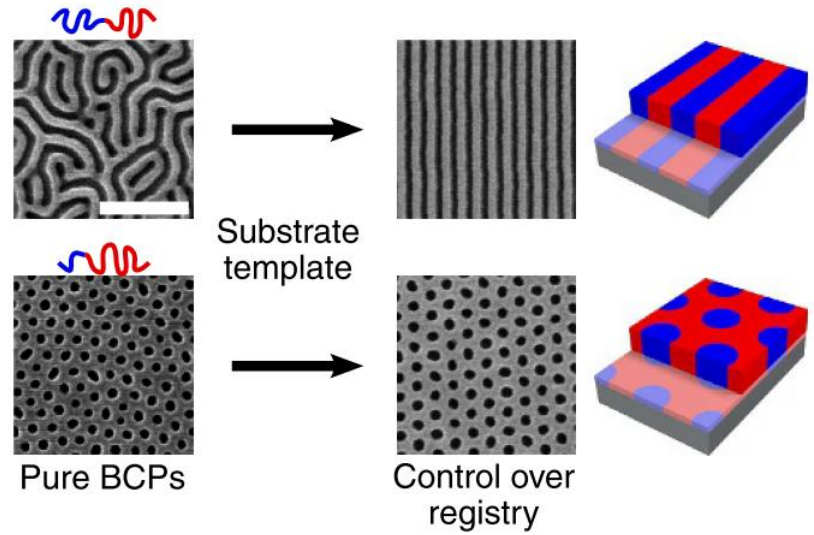


Higher flexibility →
Possibility of controlling nanostructures organization by tuning monomer length

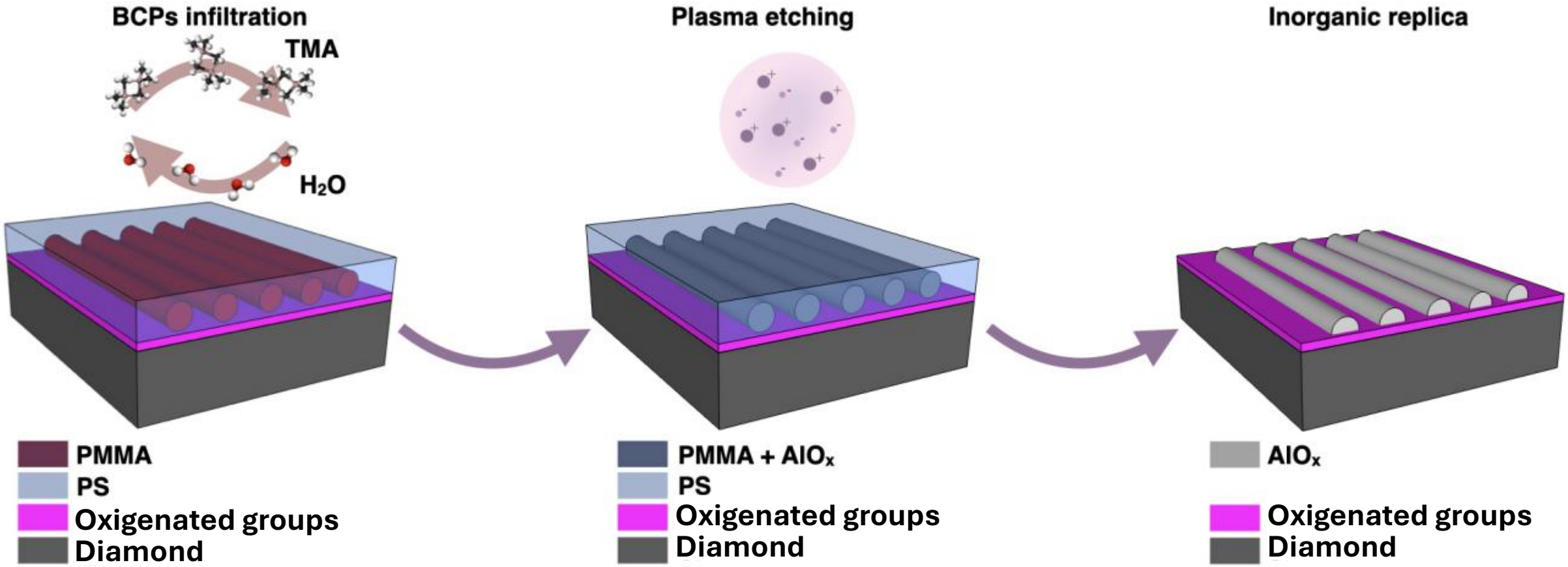
Higher scalability →
Possibility of patterning large surface area (whole diamond surface)

Higher spatial resolution →
Structures patterned are at the nanoscale level

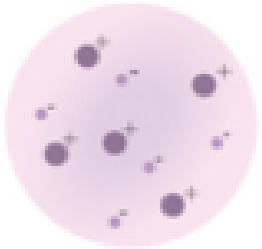




Self-Assembly of Block copolymers PS-b-PMMA on Diamond surface



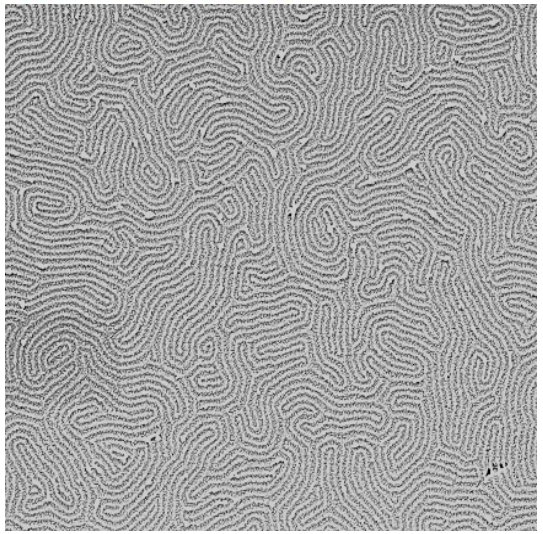
Sequential Infiltration Synthesis (SIS) of Block Copolymers (BCPs)

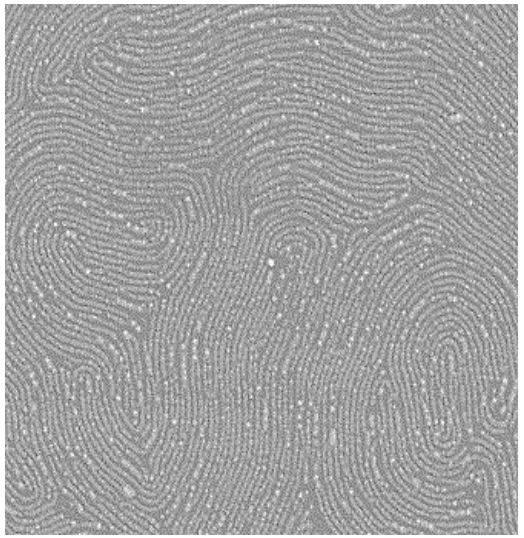


Metal oxide as hard mask for subsequent RIE

- ***Pattern transfer by reactive ion etching (RIE)***
- ***Metal oxide removal (Sodium hydroxide)***

Scaning electron microscopy (SEM)





✓ *Plasma etching*

Call CSN 5 – DIOMEDES :

“Detector Innovation and custOM Electronics for DEcay Spectroscopy”

Sezioni coinvolte: Milano, LNL, Torino, Padova

Coordinatore nazionale: Stefano Capra (UniMi)

Coordinatore locale: Sviatoslav Ditalia Tchernij

Obiettivo: Sviluppo di rivelatori al Ge per la rivelazione di prodotti di decadimento di fasci ionici radioattivi con energie di ≈100 GeV
(Presso SPES @ LNL)

Contributo Torino: utilizzo impiantatore ionico per drogaggio del Ge impiegato nei detector

Budget richiesto per Torino: 80 k€
FTE Torino: 1.5