# On-Demand Bioactivation of Inert Materials With Plasma-Polymerized Nanoparticles

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**Introduction:** The performance of materials employed in biomedical applications is profoundly influenced by their interactions with proteins, cells, and tissues at the implantation site. Our study sought to employ a novel nanocarrier platform as a new way to functionalise inert polymeric materials including hydrogels and porous constructs.

**Approach:** We were the first to collect and characterize the 'plasma dust', which has long been known to form in particulate-rich 'dusty' plasmas, for biological applications[1]. Plasma dust nanoparticles (called plasma polymerized nanoparticles or PPN) retain many of the favourable physical and chemical properties known for plasma thin films, including hydrophilicity and linker-free biomolecule binding. Here we propose to use PPN as a fundamentally new plasma-derived surface modification approach for functionalizing materials, available as an off-the-shelf and on-demand surface functionalization tool in vials (**Figure1**).

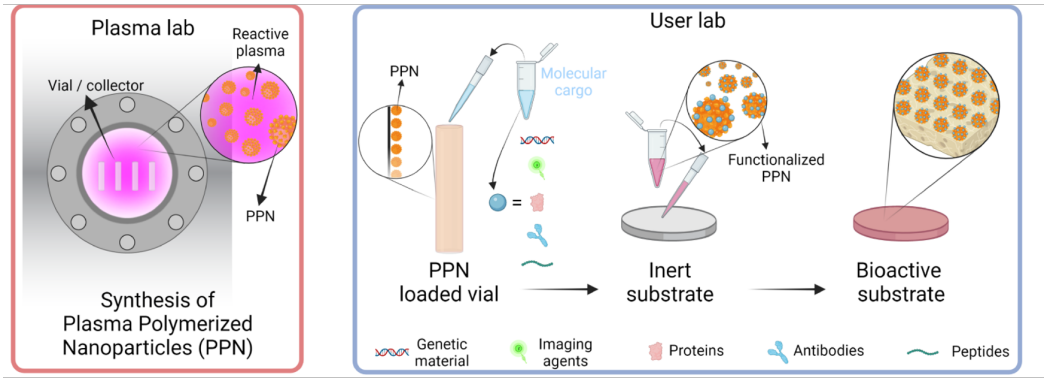


Figure 1. Schematic of PPN production and functionalization of inert substrates

**Results:** We show that adsorption of PPN leads to an activation of a range of material surfaces, prompted by changes in surface chemistry and enhanced hydrophilicity. We further demonstrate that PPN can be robustly immobilized onto inert substrates (e.g. PCL, polypropylene, silk and cellulose), resisting washing and desorption. Materials functionalization with arginylglycylaspartic acid (RGD)-loaded PPN significantly enhanced cell attachment, spreading, and substrate coverage on inert scaffolds compared to passive RGD coatings. Improved adhesion to complex geometries and subsequent differentiation following growth factor exposure is also demonstrated[2].

**Conclusion:** This research introduces a novel substrate functionalization approach that mimics the outcomes of plasma coating technology but vastly expands its applicability, promising advancements in biomedical materials and devices.

**References:**

1 Santos, M. *et al. ACS Applied Nano Materials* **1**, 580-594 (2018).
2 Santos, M. *et al. Advanced Materials* **2311313** (2024).