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LINEAR PROPULSION OF GOLD-NICKEL-PLATINUM NANOJET STEERED BY DUAL OFF-CENTER NANOENGINES

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A novel nanojet with dual off-center nano-engines consisting of gold (Au), nickel (Ni) and platinum (Pt) is designed. Au and Ni are shaped as a concentric disk with 12 μm in diameter. The thicknesses of Au- and Ni-disks are 0.2 and 0.1 μm, respectively. Two identically off-center Pt nozzle nanoengines form cylindrical chambers and are symmetrically distributed on the base of the Au-Ni disk. The diameter, bottom-thickness, wall-height and wall-thickness of the nozzle nanoengines are 3, 0.3, 1.5 and 0.3 μm, respectively. A propulsion mechanism for the Au-Ni-Pt nanojet. Without the presence of hydrogen peroxide (H_2O_2), the nanojet suspended in deionized (DI) water is stationary. After the addition of H_2O_2 into DI water, oxygen (O_2) bubbles are generated at the Pt-surface (the nanojet and O_2 bubbles have a joint velocity of v1). The generated O_2 bubbles grow bigger. At this state, the nanojet and O_2 bubbles have a same velocity of v2. When O_2 bubbles reach a certain diameter, they detach from the surface of the nanojet. The nanojet has a velocity of v3, while O_2 bubbles have a different velocity of v0. According to the momentum conservation law and the momentum theorem, a driving force *F'drive* is generated, resulting from momentum change induced by the detachment of O_2 bubbles, to thrust the nanojet propelling forward. The nanojet is equipped with two identically and symmetrically distributed off-center nanoengines, resulting in the total driving force *F'drive* is well aligned with the drag force Fdrag. Hence, the Au-Ni-Pt nanojet propels forward linearly. At steady state, the nanojet will continuously propel forward at a speed of v.

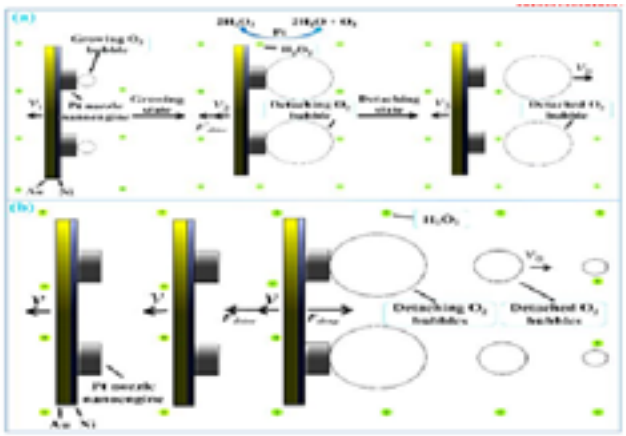

Figure.2: Schematic diagram depicting the propulsion mechanism for the Au-Ni-Pt nanojet in H_2O_2 solution. (a) Illustration of Au-Ni-Pt nanojet's propulsion originated from momentum change, resulting from the detachment of O_2 bubbles from H_2O_2 decomposition catalyzed by Pt; (b) Demonstration of the linear propulsion of the Au-Ni-Pt nanojet steered by dual off-center nanoengines in H_2O2 solution