Monitoring Fruit Tree Health: Nanomaterial-Driven Sensors and Power Systems in a Multifunctional Platform – MOSSA

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Studying volatile compounds emitted by plants is crucial in modern agriculture as these compounds provide insights into plant health, environmental interactions, and crop management. Volatile organic compounds released by plants (PVOCs) serve as chemical signals, facilitating communication between plants and organisms like pollinators, herbivores, and beneficial microorganisms. Understanding plant volatiles aids researchers and farmers in decoding plant physiology, stress responses, and defense mechanisms. Monitoring PVOCs allows for early detection of pest infestations and disease outbreaks, enabling timely interventions that reduce the need for chemical pesticides and minimize crop losses. By leveraging volatile signals, farmers can improve resource allocation, boost crop yield and quality, and lessen environmental impact.

The MOSSA project aims to develop a digital platform featuring sensors to monitor plant health, integrating them into an IoT system supported by efficient energy harvesting. This platform comprises three units:

- The TREE unit, which tracks plant physiological aspects like water consumption, biomass growth, and leaf stability
- The VOC unit, which detects volatile organic compound emissions
- The solar energy supply unit

Nanomaterials are essential in this system, enabling the creation of highly selective sensors for terpenes and solar cell modules using nano-sized perovskite thin films. The sensor unit employs electrospinning nanotechnology (ES) and molecularly imprinted polymers (MIPs) for precise terpene detection. Electrospinning sensors offer sensitivity, selectivity, versatility, and scalability, making them ideal for various applications. This innovative device accurately detects target terpenes like limonene and linalool with exceptional sensitivity. The light harvester is a 450 nm 3D perovskite (1.65 eV band gap) between the ETL and HTL layers. The ETL includes compact and mesoporous TiO2, which provides scaffolding for crystal growth and facilitates charge extraction/collection at the negative electrode. Such solar cell modules effectively harvest solar energy.