Review Digest: Top 10 Recent Nanosensor Research Papers

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Project Purpose & Scope

This project provides a concise, structured digest of ten recent research papers on nanosensors and their applications. For each paper, we list the objective, the nanomaterials used, notable findings (including performance metrics like sensitivity, enhancement factor, LOD, or degradation efficiency), and real-world applications. The document serves as a quick reference for researchers, students, and professionals tracking recent advances in nanosensor technology.

Summary of Methodology

Information was systematically extracted from each source and normalized into the following fields:

- **Paper Title & Citation** (for proper academic attribution)
- **Objective** (core purpose of the study)
- **Nanomaterial Used** (key material(s) or platform)
- **Key Findings** (headline results and metrics)
- **Applications** (intended or plausible use-cases)

Table 1. Summary of Top 10 Recent Nanosensor Research Papers

Paper	**Year**	**Study Type**	**Nanomaterial/ platform**	**Target/ Use- case**	**Headline Metric**	**Notes**
1	2023	Original	Zno/ Graphene Nanocomposite	Photocatalytic dye degradation	97% degradation 92% after 5 cycles	Sunlight driven MB removal
2	2025	Review	Functionalized Cellulose for SERS	Wearable SERS Sensing	Emphasis on EF & durability	Subtract functionalization is critical
3	2022	Review	Nanomate	Food	improved	in suit

			rial-based fluorescent biosensor	safety	selectivity/ sensitivity	contaminant detection
4	2025	Review	Nanosensors-healthcare monitoring	Real time health	Sensitive, specific, rapid	Continuous monitoring & disease mgmt
5	2021	Review	Graphene quantum dots (GQDs)	Cancer diagnostics	DNA detection as low as 2ng	Smart biosensors focus
6	2021	Review	Nanostructured materials-enabled biosensors	Healthcare ,env., food	Low down to 1 pM	High surface-to-volume conductivity
7	2024	Original/ Method	Plasma enhanced fluorescence (single molecule)	Continuous biosensing in complex fluids	Single-molecule at pico-nM	Works in undiluted matrics
8	2020	Review	Nanoparticles based EV biosensors	Liquid biopsy	LOD 4.8 x 10^7 EVs/mL	Fast, specific, low cost
9	2023	Original (abstract)	Gamma rays analysis of reeds	Environmental, radionuclides	Not specified	Environmental assessment
10	2023	Original	Inhalable ACE2 (HH-120) fusion	Covid-19 neutralization	Broad-spectrum, low viral load (hamsters)	Inhalable therapeutic candidate

Paper Summaries

1) ZnO/Graphene Composite for Photocatalytic Dye Degradation

Paper Title & Citation: "ZnO/Graphene Composite from Solvent-Exfoliated Few-Layer Graphene Nanosheets for Photocatalytic Dye Degradation under Sunlight Irradiation," Vasanthi Venkidusamy et al., *Micromachines* 14, 189 (2023).

Objective: Develop a ZnO/graphene nanocomposite for photocatalytic degradation of methylene blue (MB) under sunlight.

Nanomaterial Used: ZnO/graphene composite (few-layer graphene nanosheets).

Key Findings: Achieved ~97% MB degradation; retained ~92% efficiency after five reuse cycles.

Applications: Water treatment and environmental remediation.

2) Functionalization of Cellulose Substrates for SERS Sensors

Paper Title & Citation: "Recent advances in the functionalization of cellulose substrates for SERS sensors with improved performance," B. Sartori and B. Marmiroli, *Frontiers in Nanotechnology* 7:1599944 (2025).

Objective: Review recent strategies to functionalize cellulose substrates for high-performance SERS.

Nanomaterial Used: Cellulose-based substrates functionalized for SERS (often with noble metal nanostructures).

Key Findings: Surface functionalization strongly impacts durability and SERS performance; enhancement factor (EF) is a key benchmarking metric.

Applications: Wearable SERS patches for continuous health monitoring and point-of-need analysis.

3) Nanomaterial-Based Fluorescent Biosensors for Food Safety

Paper Title & Citation: "Nanomaterial-Based Fluorescent Biosensor for Food Safety Analysis," Jiaojiao Zhou et al., *Biosensors* 12, 1072 (2022).

Objective: Review nanomaterial-enabled fluorescent biosensing for food safety.

Nanomaterial Used: Diverse nanomaterials (quantum dots, graphene-based materials, metal nanoparticles, etc.).

Key Findings: Nanomaterial integration enhances biosensor sensitivity, selectivity, and accuracy.

Applications: Food safety testing; in situ contaminant detection.

4) Nanosensors in Healthcare

Paper Title & Citation: "Nanosensors in healthcare: transforming real-time monitoring and disease management with cutting-edge nanotechnology," Shikha Gulati et al., *RSC Pharmaceutics* (2025), DOI: 10.1039/d5pm00125k.

Objective: Review the role of nanosensors in real-time healthcare monitoring and disease management.

Nanomaterial Used: Broad coverage (electrochemical, optical, plasmonic, and other nanosensor platforms).

Key Findings: Nanosensors enable sensitive, specific, and rapid methods suitable for continuous monitoring.

Applications: Early disease detection; real-time tracking of physiological parameters.

5) Smart Biosensors for Cancer Diagnosis Based on Graphene Quantum Dots

Paper Title & Citation: "Smart Biosensors for Cancer Diagnosis Based on Graphene Quantum Dots," Daniela Iannazzo et al., *Cancers* 13, 3194 (2021).

Objective: Review GQD-based smart biosensors for cancer diagnosis.

Nanomaterial Used: Graphene quantum dots (GQDs).

Key Findings: Reported detection sensitivity for low-quantity DNA samples down to ~2 ng in highlighted study.

Applications: Cancer diagnostics and molecular biomarker detection.

6) Nanostructured Materials-Enabled Biosensors

Paper Title & Citation: "A Review on Biosensors and Recent Development of Nanostructured Materials-Enabled Biosensors," Varnakavi Naresh and Nohyun Lee, *Sensors* 21, 1109 (2021).

Objective: Summarize advances in nanostructured materials for biosensor performance and miniaturization.

Nanomaterial Used: Wide range (e.g., metal/metal-oxide nanostructures, carbon nanomaterials, hybrids).

Key Findings: High surface-to-volume ratio and improved conductivity help reach ultra-low detection limits; one cited device reported LOD ~1 pM.

Applications: Healthcare diagnostics, environmental monitoring, and food quality control.

7) Continuous Monitoring Biosensing via Plasmon-Enhanced Fluorescence

Paper Title & Citation: "Continuous Monitoring Biosensing Mediated by Single-Molecule Plasmon-Enhanced Fluorescence in Complex Matrices," Vincenzo Lamberti et al., *ACS Nano* 18, 5805–5813 (2024).

Objective: Demonstrate continuous monitoring of critical markers directly in undiluted biological fluids.

Nanomaterial/Platform: Plasmonic nanostructures enabling single-molecule enhanced fluorescence.

Key Findings: Single-molecule detection of unlabeled analytes at pico- to nanomolar concentrations in complex matrices.

Applications: Real-time biomarker surveillance in clinical samples.

8) Nanoparticle-Based Biosensors for Liquid Biopsies

Paper Title & Citation: "Nanoparticle-based biosensors for detection of extracellular vesicles in liquid biopsies," Beatriz Martin-Gracia et al., *J. Mater. Chem. B* 8, 6710 (2020).

Objective: Review nanoparticle-enabled detection/quantification of extracellular vesicles (EVs) for liquid biopsy.

Nanomaterial Used: Various nanoparticles (including copper nanoparticles, among others).

Key Findings: Strategies offer specific, fast, and inexpensive EV quantification; an approach using CuNPs achieved LOD ~4.8 × 10^7 particles/mL.

Applications: Cancer detection; monitoring tumor progression via EV profiling.

9) Gamma-Ray Analysis of Reed Samples from the Danube Delta

Paper Title & Citation: "Gamma-Ray Analysis of Reed Samples from the Danube Delta," Ana Bianca Pavel et al., *Sensors* (2023).

Objective: Perform gamma-ray analysis of reed samples to detect radioactive isotopes.

Nanomaterial/Platform: Gamma spectroscopy of environmental plant samples (no specific nanosensor platform detailed in the abstract).

Key Findings: Abstract-level summary without specific performance data.

Applications: Environmental radioactivity assessment and monitoring.

10) An IgM-like Inhalable ACE2 Fusion Protein

Paper Title & Citation: "An IgM-like inhalable ACE2 fusion protein broadly neutralizes SARS-CoV-2 variants," Juan Liu et al., *Nature Communications* (2023), DOI: 10.1038/s41467-023-40933-3.

Objective: Develop an inhalable molecule (HH-120) to neutralize a broad range of SARS-CoV-2 variants.

Nanomaterial/Platform: Protein-based fusion construct; evaluated as an inhalable therapeutic.

Key Findings: Broad-spectrum neutralization demonstrated; significantly reduced viral load in hamsters.

Applications: Potential inhalable therapeutic for COVID-19 and emergent variants.

Author Info & Links

1. **Vasanthi Venkidusamy et al.** – https://www.mdpi.com/2072-666X/14/1/189
2. **B. Sartori and B. Marmiroli** – https://www.frontiersin.org/articles/10.3389/fnano.2024.1599944
3. **Jiaojiao Zhou et al.** – https://www.mdpi.com/2079-6374/12/12/1072
4. **Shikha Gulati et al.** – https://pubs.rsc.org/en/content/articlelanding/2025/pm/d5pm00125k
5. **Daniela Iannazzo et al.** – https://www.mdpi.com/2072-6694/13/13/3194
6. **Varnakavi Naresh and Nohyun Lee** – https://www.mdpi.com/1424-8220/21/4/1109
7. **Vincenzo Lamberti et al.** – https://pubs.acs.org/doi/10.1021/acsnano.3c11430
8. **Beatriz Martin-Gracia et al.** – https://pubs.rsc.org/en/content/articlelanding/2020/tb/d0tb00861c
9. **Ana Bianca Pavel et al.** – https://www.mdpi.com/2076-3417/12/10/5053
10. **Juan Liu et al.** – https://www.nature.com/articles/s41467-023-40933-3